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TRAINING EFFECTIVENESS AND RETENTION OF TRAINING EXTENSION COURSE (TEC) INSTRUCTION IN THE COMBAT ARMS

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U. S. Army

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The Army's Training Extension Course (TEC) Program consists of a large number of performance-oriented self-paced lessons (mainly audiovisual) designed to provide individual instruction for enlisted men in Army units. The TEC lessons cover a wide range of subject areas in which soldiers must be proficient. This report describes a research project designed to determine the training effectiveness and retention of TEC instruction relative to conventional classroom instruction.

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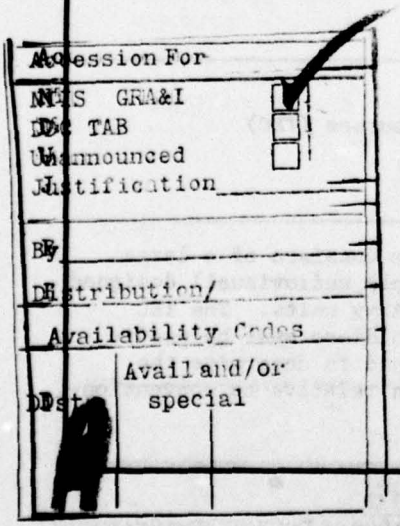
20. Abstract (Continued)

Parallel experiments were conducted in the Active Component (AC) and the National Guard (NG). TEC lessons in five subject areas were selected for evaluation. The sample for each subject area was divided into five experimental groups. Two of these groups received TEC instruction, one with pre- and post-testing, the other without. Two other groups received conventional instruction, one with and one without pre- and post-testing. The pre- and post-tests are diagnostic tests included in the Lesson Administrative Instructions (LAI) that accompany each TEC lesson. The experimental design allowed evaluation of the contribution of these tests to training effectiveness. The fifth experimental group received no instruction and no LAI pre- or post-testing. This group served as a baseline for the other four.

The instructors for the groups receiving conventional instruction came from the units being tested. On the day following instruction, all soldiers (including those in the baseline groups) were given a hands-on performance test covering the subject area in which instruction was given. Between eight and nine weeks after the instruction, the hands-on test was readministered to as many of the original AC sample as could be obtained. For NG units, the test-retest interval ranged from seven to twelve weeks.

Averaged across the five subject areas, the TEC trained soldiers performed better than the conventionally trained soldiers on both the initial and retention test. Soldiers given pre- and post-testing performed slightly better on the average than those receiving instruction without pre- and post-testing, although the difference was not statistically significant. The baseline group had the lowest level of performance in all subject areas. The four groups receiving instruction showed about the same average amount of forgetting between the initial and retention test. All of the above findings apply to both the AC and the NG.

Data on TEC effectiveness, when combined with usage and cost data, allow determination of the cost-effectiveness of the TEC program. The effectiveness and retention findings will also be used as input to the development of an implementation plan designed to increase the cost-effectiveness of the TEC program.



Research Report 1208

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Individual Training

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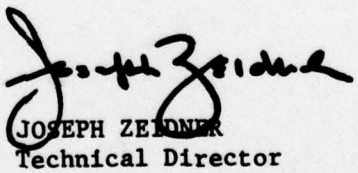
FOREWORD

The research reported here is part of an on-going program of research directed toward development of cost effective methods for individual and collective training. This program includes research on multiple aspects of the design, development, evaluation, and integration of cost and training effective training systems for the U. S. Army.

This report is one of a series of research efforts on the Training Extension Course (TEC) program conducted under the sponsorship of the U.S. Army Training Support Center (USATSC) - Training Programs Directorate. This program has included detailed research into the training effectiveness and retention of TEC instruction (reported here), the current and programmed costs of the TEC program, current and projected usage of TEC in the Active and Reserve components, and analytic examination of the cost effectiveness of TEC. Research results are to be used by USATSC-TPD to determine both future program needs and future models and strategies for better implementation of the TEC system as a major component of the Enlisted Personnel Management System (EPMS).

ARI research in cost effectiveness of training systems is conducted as an in-house effort augmented by contracts with organizations selected as having unique capabilities for research in the area. This research program is being performed by the ARI-Fort Benning Field Unit with research support provided by Litton-Mellonics under contract DAHC-77-C-0011. The project is being conducted as part of Army Project 2Q763731A770, FY 77 Work Program, and 2Q763731A770, FY 78 Work Program. This research program is directly responsive to the requirements of USATSC and TRADOC.



JOSEPH ZEIDNER
Technical Director

THE TRAINING EFFECTIVENESS AND RETENTION OF TEC INSTRUCTION IN THE COMBAT ARMS

BRIEF

Requirement:

To determine the training effectiveness and retention of Training Extension Course (TEC) instruction relative to conventional instruction.

Procedure:

TEC lessons were evaluated in five subject areas, one common to all combat arms soldiers and one specific to each of the four combat arms. The subject areas were (1) M60 Machinegun for all combat arms, (2) Squad Radio for Infantry soldiers, (3) M551 Target Engagement for Armor soldiers, (4) Gunner's Quadrant for Field Artillery soldiers and (5) Target Alert Data Display Set (TADDS) for Air Defense soldiers.

Parallel experiments were conducted in the Active Component (AC) and the National Guard (NG). A total of 635 enlisted men were obtained from twelve AC battalions, three battalions in each of the four combat arms. The NG provided 539 men from thirteen battalions. Four NG Field Artillery battalions were needed to obtain the required sample size for the Gunner's Quadrant subject area. All four combat arms provided men for the M60 machinegun subject area, while the sample for each of the other four areas came from a single combat arm.

The sample for each subject area was divided into five experimental groups. Two of these groups received TEC instruction, one with pre- and post-testing, the other without. Two other groups received conventional instruction, one with and one without pre- and post-testing. The pre- and post-tests are diagnostic tests included in the Lesson Administrative Instructions (LAI) that accompany each TEC lesson. The experimental design allowed evaluation of the contribution of these tests to training effectiveness. The fifth experimental group received no instruction and no LAI pre- or post-testing. This group served as a baseline for the other four.

The instructors for the groups receiving conventional instruction came from the units being tested. On the day following instruction, all soldiers (including those in the baseline groups) were given a hands-on performance test covering the subject area in which instruction was given. Between eight and nine weeks after the instruction, the hands-on test was readministered to as many of the original AC sample as could be obtained. For NG units, the test-retest interval ranged from seven to twelve weeks.

Findings:

Averaged across the five subject areas, the TEC trained soldiers performed better than the conventionally trained soldiers on both the initial and retention test.

Soldiers given pre- and post-testing performed slightly better on the average than those receiving instruction without pre- and post-testing, although the difference was not statistically significant.

The baseline group had the lowest level of performance in all subject areas.

The four groups receiving instruction showed about the same average amount of forgetting between the initial and retention test.

All of the above findings apply to both the AC and the NG.

Utilization of Findings:

Data on TEC effectiveness, when combined with usage and cost data, allow determination of the cost-effectiveness of the TEC program. The effectiveness and retention findings will also be used as input to the development of an implementation plan designed to increase the cost-effectiveness of the TEC program.

THE TRAINING EFFECTIVENESS AND RETENTION OF TEC INSTRUCTION IN THE COMBAT ARMS

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TRAINING EFFECTIVENESS AND RETENTION OF TRAINING EXTENSION COURSE (TEC) INSTRUCTION IN THE COMBAT ARMS

In response to an acknowledged need for better individual training in combat arms units, the Combat Arms Training Board was established and in 1972 began development of the Training Extension Course (TEC) program. The TEC program was designed to assist combat arms soldiers and unit commanders in upgrading Military Occupational Specialty (MOS) and job proficiency by providing to units in the field multimedia instructional materials prepared by the service schools.

Since its inception, the TEC program has gone through a number of phases of development. In the initial phase, 56 audiovisual lessons were developed in a sound-slide format covering skills required of soldiers with MOS 11B. The second phase began in 1973 and involved development of a large number of lessons for eight initial combat arms MOSs, 11B and 11C for Infantry, 11D and 11E for Armor, 13A/B and 13E for Field Artillery, and 16P and 16R for Air Defense. During this phase, TEC lessons and hardware were distributed to all combat arms battalions in the Army. The TEC program has continued to expand during subsequent phases of development and is currently being extended to cover combat service and service support units.

TEC differs from conventional Army training in a number of ways. First, TEC lessons are intended to be performance oriented. Specific performance-oriented training objectives are determined for each lesson prior to lesson development and the lesson is designed to teach to those objectives. Second, a diagnostic test is included with the Lesson Administrative Instructions (LAI) which accompany each TEC lesson. The purpose of the test is to determine the areas covered by the lesson in which a soldier is weak. Third, TEC lessons are designed for self-paced training. Fourth, each TEC lesson goes through a validation process designed to insure that each lesson provides effective training on every lesson objective. The majority of TEC lessons (77 percent as of September, 1977) are in the form of audio-visual packages designed for use with a Beseler Cue/See viewing device. This research effort evaluated the effectiveness of a sample of these audio-visual lessons.

A number of projects have investigated various aspects of the TEC program, one of which is closely related to this effort. In

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[1]Commercial designations are used for precision of reporting and do not constitute endorsement by ARI or by the Army.

conjunction with investigations of TEC usage[1] and costs[2], Knerr, Downey and Kessler[3] evaluated TEC lesson effectiveness. They conducted a field experiment in both the Active and Reserve Components of the Army comparing TEC training with conventional instruction (CI) and a no-training baseline (BL) for five TEC lesson series. The TEC soldiers were given the LAI test for each lesson both before and after viewing the lesson. They were also given feedback on their performance immediately after taking each LAI test. The CI soldiers received all LAI tests at once, followed by conventional instruction, followed by a second administration of the LAI tests. These soldiers received no feedback on LAI test performance. The BL soldiers took the LAI tests in the same sequence as the CI soldiers, but with no intervening instruction. After training, all soldiers were given a hands-on performance test covering the subject on which they were trained. These performance tests were modified versions of existing tests.

Knerr et al.[4] found that for their active component sample, the mean percent correct on the performance test for the TEC soldiers was significantly higher than the BL mean for four out of the five lesson series. TEC performance was significantly higher than CI performance for three lesson series. For the National Guard sample only four of the five lesson series were evaluated. TEC was superior to BL in all four cases and superior to CI in two cases. There were no cases in either the active or National Guard sample for which either the CI or BL group performed significantly better than the TEC group. An interesting finding in this investigation concerned the correlation between the General Technical

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1 McClusky, Michael R. and Tripp, James M. An evaluation of the utilization, maintenance and perceived benefits of the Training Extension Course (TEC) (Tech, Rep. 75-18). Alexandria, VA: Human Resources Research Organization, June 1975.

2 Temkin, Sanford, Conolly, J. A., Marvin, M.D., Valdes, A. L. and Caviness, J. A. A cost assessment of Army training alternatives. ARI Research Problem Review 75-3. August 1975.

3 Knerr, Claramae S., Downey, Ronald G. and Kessler, John J. Training individuals in Army units: Comparative effectiveness of selected TEC lessons and conventional methods. ARI Research Report 1188. December 1975.

4 Knerr, et al., 1975, op. cit.

aptitude area (GT) scores from the Armed Services Vocational Aptitude Battery and the performance test scores for TEC and CI groups in the Active Component sample. While for the CI soldiers there was a significant positive correlation between GT and performance test score, the correlation for the TEC soldiers was near zero. TEC training led to roughly equal performance levels for low and high GT soldiers. However, in the National Guard, high GT soldiers performed better than low GT soldiers following both TEC and conventional training.

OBJECTIVES

The primary objective of the present effort is to update and expand upon the findings of Knerr et al.[5] concerning TEC lesson effectiveness. Besides comparing TEC instruction to conventional instruction for a larger number of MOSs and for five lesson series not evaluated in that effort, the present research addresses two new questions. First, how does retention of TEC instruction compare to retention of conventional instruction? Second, what do the LAI tests and feedback on test performance contribute to the performance of soldiers trained with TEC or conventional instruction? In the Knerr et al.[6] project all subjects received the LAI tests both before and after instruction. However, current data on TEC usage patterns indicate that soldiers in the field usually do not use the LAI tests.[7] It is therefore of interest to determine how much those tests contribute to the effectiveness of TEC lessons.

An important difference between the present effort and earlier evaluations of TEC lesson effectiveness concerns the performance tests used as dependent variables. Instead of using existing tests, a new performance test was developed and validated for each TEC lesson series used in this project. The validation process involved both review by subject matter experts and field tryout.

LESSONS USED

Five TEC lesson series were selected for evaluation in this effort. The five lesson series selected included one specific to

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5 Knerr, et al., 1975, op. cit.

6 Knerr, et al., 1975, op. cit.

7 Mays, P. V., Holmgren, J. E. and Shelnutt, J. B. Current use, patterns of use and factors affecting use of the Army Training Extension Course (TEC) Program. ARI Technical Report TR-79-A3, May 1979.

each of four major Army combat arms (Field Artillery, Air Defense Artillery, Armor, and Infantry) and one series of lessons common to all combat arms MOSs. One performance test was developed for each of the five lesson categories.

The selected Field Artillery lessons covered the use of a Gunner's Quadrant, a device employed for measuring the angle of elevation of a howitzer tube in artillery firing tasks. The performance test included actual measurement tasks using a Gunner's Quadrant, with a variable inclined plane employed as a simulator for the howitzer tube.

Lessons on the use of the Target Alerting Data Display Set (TADDS) were selected for Air Defense Artillery (ADA) soldiers. The TADDS is a receiving unit for a field radar system. The TADDS receives and displays information from the Forward Area Alerting Radar (FAAR) on the location of friendly and unknown incoming aircraft.

For Armor soldiers, the selected lessons provided instruction on engagement of targets with the M551 Armored Reconnaissance Vehicle. The performance measures on the associated test required the appropriate alignment of various target pictures within a simulated M551 aiming reticle. The simulation involved manipulation of plastic reticle overlays on the target pictures for various target and range configurations.

Lessons on the use of the Squad Radio were selected for use with Infantry soldiers. The Squad Radio performance test required that various operational transmission and maintenance tasks be performed using a hand-held Squad Radio.

The lessons selected as common to all combat arms soldiers covered mechanical training along with firing and zeroing of the M60 machinegun. The performance test required performance of a variety of tasks including assembly, disassembly and operational checks using an M60 machinegun. No simulators were employed.

PROCEDURES

Parallel experiments were conducted in the Active Component (AC) and the National Guard(NG). A total of 635 enlisted men were obtained from twelve AC battalions, three battalions in each of the four combat arms. The NG provided 539 men from thirteen battalions. Four NG Field Artillery battalions were needed to obtain the required sample size for the Gunner's Quadrant subject area. All four combat arms provided men for the M60 machinegun subject area, while the sample for each of the other four areas came from a single combat arm. The sample for each subject area

was divided into five experimental groups as follows:

Group TL - TEC instruction with LAI pre- and post-testing.

Group TO - TEC instruction only; neither pre- nor post-testing.

Group CL - Conventional instruction with LAI pre- and post-testing.

Group CO - Conventional instruction only; neither pre- nor post-testing.

Group BL - Baseline group receiving no instruction and no pre- and post-testing.

The instructors for the groups receiving conventional instruction came from the units being tested. On the day following instruction, all soldiers (including those in the BL groups) were given a hands-on performance test covering the subject area in which instruction was given. Between eight and nine weeks after the instruction, the hands-on test was readministered to as many of the original AC sample as could be obtained. For NG units, the test-retest interval ranged from seven to twelve weeks.

RESULTS

For all soldiers, each item on each performance test was scored GO or NO GO. The proportion of items scored GO was computed for each soldier and then averaged across the soldiers in each experimental group. This was done for both the initial and retention tests in each subject area. The initial performance test means for each of the four groups that received training (TL, TO, CL and CO) were then corrected, using the BL means, in order to estimate for each group the amount that was learned during the experimental training over and above what was known through prior training and experience. The retention test scores were also corrected using the BL means; the purpose of this correction was to adjust the retention test scores not only for prior training and experience but also for the effect of the initial test on retention test performance. The method used to make these corrections and the underlying rationale are described in the Technical Supplement.

Active Component Results

Figure 1 gives the mean corrected score on the initial and retention tests for each of the four AC groups that received training. Each mean score is the average across the five subject areas. The

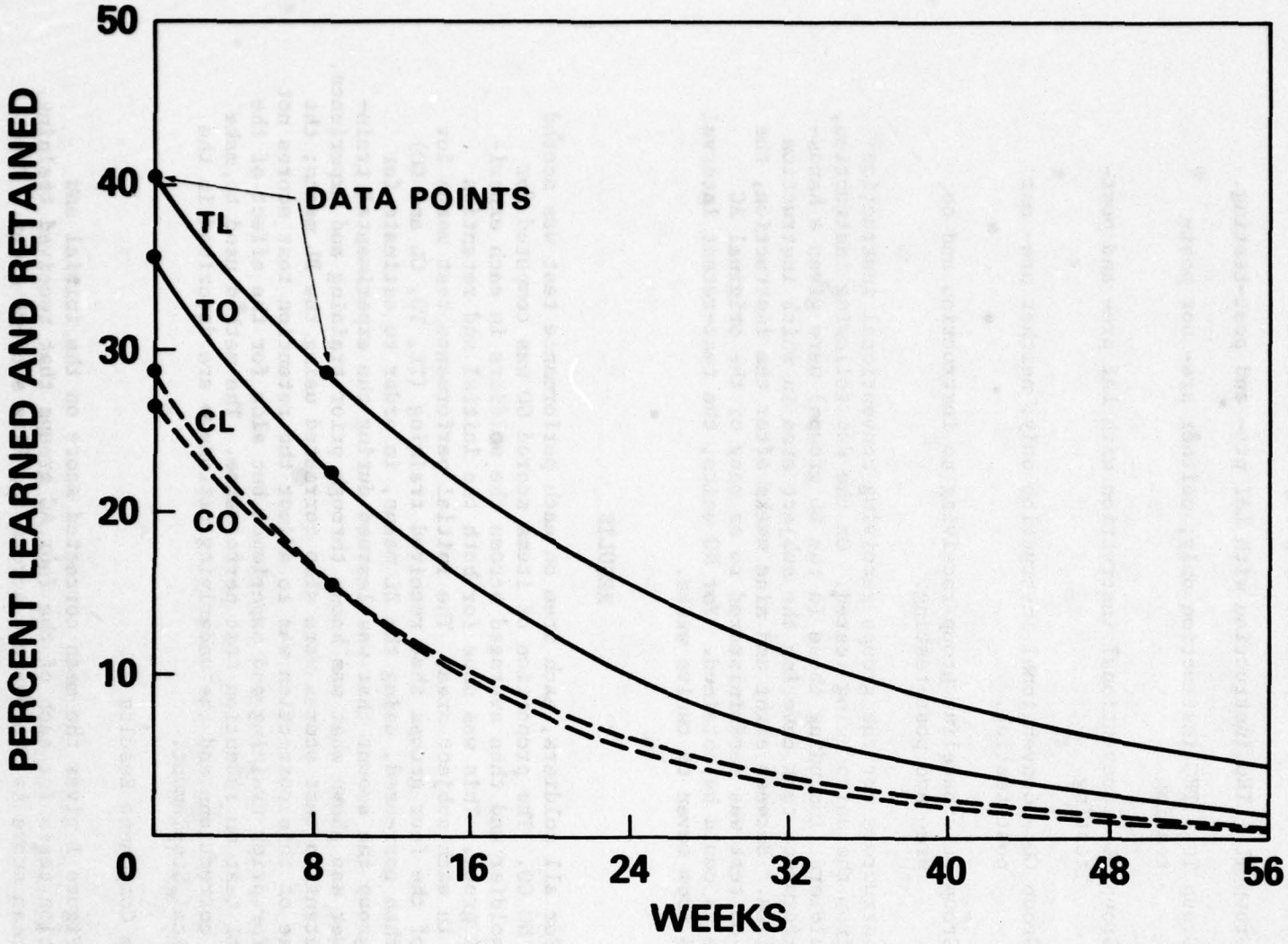

Figure 1. Active Component retention curves.

initial test means are based on only those soldiers who were available for the retention test. The curve passing through the two data points for each experimental group was fitted to the data under the assumption that the amount of learned material retained decays exponentially over time. Statistical tests show that the TEC trained soldiers performed better than the conventionally trained soldiers on both the initial and retention test. As the curves indicate, it is projected that the advantage of TEC over conventional instruction would persist over an extended period of time. The difference between the performance of soldiers receiving pre- and post-testing and those receiving no pre- and post-testing is not statistically significant. Also, there are no significant differences among the four groups in the decay rates of the exponential curves, although the decay rates for both TEC trained groups are slightly less than those for the conventionally trained groups.

Considering each subject area separately, the performance of the TEC trained soldier was superior to the performance of the conventionally trained soldiers on both the initial and retention test in four of the five subject areas, although for Squad Radio the initial test difference is not statistically significant. Only for the Gunner's Quadrant subject area is there no evidence of a statistically significant difference between TEC and conventional instruction. In none of the subject areas is the difference between performance with and without LAI testing statistically significant. Also, for none of the subject areas is there a significant difference between the TEC and conventional groups in the correlation between GT scores and performance test scores. The correlation tended to be positive for both TEC and conventional instruction.

National Guard Results

Figure 2 gives the mean corrected performance test scores for each of the four NG groups that received training, along with the fitted exponential retention curves. The mean initial test score for the TEC trained soldiers is significantly higher than the mean for conventionally trained soldiers. The difference between TEC and conventional performance on the retention test is not statistically significant, although the TL mean is significantly greater than the combined mean of the other three groups. There are no significant differences among the decay rates of the four NG retention curves. The TL and CL groups have virtually identical decay rates, while the CO group has the next highest rate and the TO group the highest.

Again considering each subject area separately, the TEC groups performed better than the conventional groups in all areas except TADDS on the initial test and in all areas except TADDS and Squad Radio on the retention test. However, the difference between TEC and conventional instruction is statistically significant only for the M60 and M551 subject areas on the initial test and only for the M551 area on the retention test. The difference between training with and without LAI

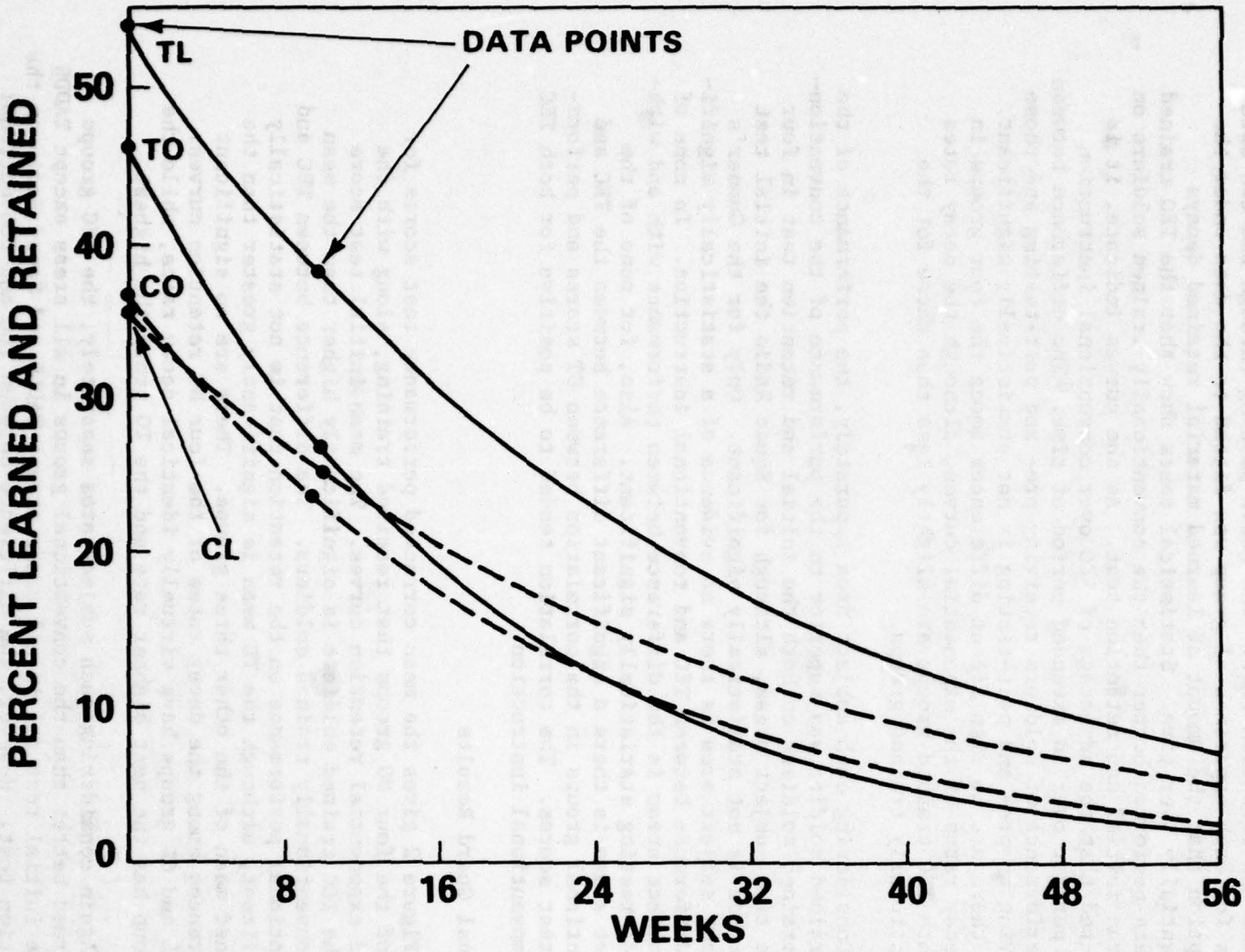

Figure 2. National Guard retention curves.

testing is significant for the M60 and Squad Radio subject areas on the initial test and for only the Squad Radio area on the retention test. The Squad Radio difference is in favor of training without LAI testing on the initial test but in favor of training with LAI testing on the retention test. This reversal may be partly explained by the fact that the initial test result is based on the full Squad Radio sample while the retention test result is based on only those soldiers available for the Squad Radio retention test. The initial test difference between instruction with and without LAI testing is not significant for the retested subsample.

Because of the limited availability of GT scores from sampled NG units, correlations between GT scores and performance test scores could be computed for only two subject areas. In one of those areas (M60), the correlation for TEC trained soldiers (.59) and the correlation for conventionally trained soldiers (-.16) are significantly different. This difference is in the opposite direction of the one found by Knerr et al.[8] for their AC sample.

CONCLUSIONS

This investigation replicates the findings of Knerr et al.[9] in showing that TEC instruction is on the average more effective than conventional instruction. In fact, the mean performance test scores for the TEC trained soldiers in the AC and NG samples, after correction for baseline performance, are remarkably similar in the two research efforts. In the Knerr et al.[10] project, the mean corrected performance test score was 40% for TEC trained soldiers in the AC sample and 45% for the NG sample. In the present effort, the comparable scores are 39% for the AC sample and 44% for the NG sample (based on full sample for the initial test). Comparing the corrected mean scores of the conventionally trained soldiers in the two projects, Knerr et al.[11] found 10% for the AC sample and 31% for the NG sample. In the present effort the AC mean is 30% and the NG mean is 34%. Thus the NG means are very similar in the two projects, while the AC conventional instruction in this effort apparently was more effective

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8 Knerr, et al., 1975, op. cit.

9 Knerr, et al., 1975, op. cit.

10 Knerr, et al., 1975, op. cit.

11 Knerr, et al., 1975, op. cit.

than in the work of Knerr et al.[12] Given that the two projects used different lesson series, different methodology and somewhat different sample populations, the similarity of the results is striking and provides support for the validity of both efforts.

Of the five TEC lesson series investigated in this effort, only one of the series (Gunner's Quadrant) produced no evidence that TEC instruction was more effective than conventional instruction. As stated earlier, all TEC lessons undergo a validation prior to being fielded. Ideally, the validation involves having a sample of soldiers view the TEC lessons and then take a performance-oriented test covering each objective in the lesson. If the soldiers meet a prespecified criterion on the test, the lesson is considered valid. An investigation of the validation carried out on the two Gunner's Quadrant TEC lessons showed that the test given after viewing of the lessons did not require actual performance with the Gunner's Quadrant. It is likely that a more performance-oriented validation test would have resulted in more effective lessons.

With regard to the comparative performance of AC and NG soldiers, the NG soldiers tended to obtain higher performance test scores than the AC soldiers, although the advantage of TEC over conventional instruction was about the same in the two samples. However, any comparisons between the AC and NG results must be made with caution, since the performance tests were not administered by the same soldiers in the two cases.

Knerr et al.[13] reported that for TEC trained soldiers there was no correlation between GT scores and performance test scores in the AC sample. This result was not replicated in the present effort. The finding here is that for both TEC and conventionally trained soldiers there is great variability among subject areas in the relation between the two measures, but higher GT scores generally tend to be associated with higher performance test scores. The advantage of TEC over conventional instruction does not appear to depend on general mental ability.

One of the objectives of this project was to look at the contribution of LAI pre- and post-testing to the effectiveness of both TEC and conventional instruction. There is no clear evidence in this effort of a difference between instruction with and without LAI testing. However, there is some indication that TEC instruction with LAI testing is more effective than without that testing. While the results were not statistically significant, soldiers in the TL groups generally performed better than the soldiers in the TO group. Also, it is important to note that regardless of the contribution of LAI testing to training effectiveness,

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12 Knerr, et al., 1975, op. cit.

13 Knerr, et al., 1975, op. cit.

such tests serve as a useful training management tool. The LAI tests were designed as a means of identifying those soldiers who need training in a subject; their usefulness in this regard is independent of any contribution they might make to the learning process.

Another objective of this project was to investigate the retention of both TEC and conventional instruction. Based on the retention interval used here, forgetting occurs at about the same rate for TEC and conventional instruction. Thus, since TEC is more effective initially, it should remain more effective over time. The extrapolation given in Figures 1 and 2 suggests what the effectiveness of TEC and conventional instruction might be at retention intervals other than the one used here. Clearly, it would be desirable to obtain data at a number of retention intervals in order to get a better picture of the actual shape of the retention curves.

It is important to bear in mind that all of the findings in this project are based on a single exposure to either TEC or conventional instruction on a topic. This effort did not address the question of how the relative effectiveness and retention of these two types of instruction would change with repeated exposure to the instruction. The results given here represent a lower bound on both the effectiveness and retention of the instruction investigated.

THE TRAINING EFFECTIVENESS AND RETENTION OF TEC INSTRUCTION IN THE COMBAT ARMS

LESSON SELECTION

Table 1 shows the TEC lessons selected for use in this study. The Status Level column in Table 1 shows a number which indicates the status of distribution of each lesson to Army field units. An entry of 1 indicates that the lesson has been distributed to the field. An entry of 2 indicates that the lesson has completed mass reproduction, but has not yet been distributed to the field. An entry of 3 indicates that the lesson is in the mass reproduction phase of development. An entry of 4 indicates that the lesson is awaiting final approval for mass reproduction.

The rationale for selection of the particular TEC lesson categories involved several considerations, including the following:

- It was necessary that one test be developed on a TEC lesson category, the topic area of which is common to all combat arms soldiers.
- It was necessary that one test be developed on a TEC lesson category in each of the four major Army Combat Arms: Field Artillery, ADA, Infantry and Armor.
- It was necessary that the tests be performance-oriented and, to the extent possible, utilize a "hands-on" testing strategy.
- The tests must be amenable to standardization in conditions for administration.
- The tests must be amenable to administration under a variety of situational and/or environmental testing contexts.
- The tests must not require excessive testing time, expensive and/or elaborate testing conditions and equipment which is not conveniently available for transportation to the test sites.
- It was desired that the tests be developed in a format similar to that utilized in the Army's Skill Qualification Testing (SQT) program.

Table 1

TEC LESSONS SELECTED FOR INCLUSION IN THE EFFORT

Lesson Identification Number	Lesson and Category Title	Applicable U.S. Army Combat Arm	TEC Status Level (1 January 1977)
	M60 Machinegun	All Soldiers	
941-071-0078-F	The M60 Machinegun: Mechanical Training, Part 1		1
941-071-0079-F	The M60 Machinegun: Mechanical Training, Part 2		4
941-071-0080-F	The M60 Machinegun: Mechanical Training, Part 3		1
941-071-0084-F	The M60 Machinegun: Firing and Zeroing		1
	Squad Radio	Infantry	
010-071-1001-F	Introduction to Squad Radio		1
010-07101002-F	Operation of the Squad Radio		1

(continued)

Table 1 (concluded)

Lesson Identification Number	Lesson and Category Title	Applicable U.S. Army Combat Arm	TEC Status Level (1 January 1977)
	M551 Target Engagement	Armor	
020-171-1643-F	Target Engagement, M551 Tank, Center of Target Mass and Aligning the Reticle		4
020-171-1644-F	Target Engagement, M551 Tank, Aligning the Reticle and Determining Range, Gunner		4
	Tube Artillery	Field Artillery	
041-061-6101-F	Test of the Gunner's Guadrant, Part 1		3
041-061-6102-F	Test of the Gunner's Quadrant, Part 2		3
	Target Alert Data Display Set (TADDS)	Air Defense Artillery	
043-441-1015-F	TADDS Emplacement and March Order		1
043-441-1016-F	TADDS Operational Checks		1
043-441-1017-F	TADDS Operation		1
043-441-1018-F	TADDS Maintenance		1

- It was appropriate to avoid use of lesson categories which had been used in previous TEC evaluation studies.

- It was appropriate, to the extent possible, to select lesson categories which were not already in widespread use by existing Army units.

The constraints that one performance test be developed in a TEC area which is common to all soldiers, and that one test be developed in each of four Army Combat Arms areas, severely restricted the choice of TEC lessons available for performance test development. In certain Combat Arms areas very few unique TEC lessons actually existed. (For example, the Squad Radio series was the only infantry-specific TEC lesson series available at the time.) Elimination of a large number of TEC lessons was thus accomplished on the basis of these two constraints. Many more were eliminated as not being sufficiently performance-oriented for use in the study. Knowledge-oriented lesson content was considered to be less applicable in the present effort than was hands-on content. From the point of view of test development, the requirement for hands-on, performance-oriented tests for use as dependent variables in the TEC effectiveness study dictated that performance-oriented TEC lessons be employed.

Further reduction of the pool of available TEC lessons was accomplished by attempting to avoid lesson categories which had been used in previous TEC program evaluation efforts (e.g Knerr et al.)[14] and by the attempt to select TEC lesson categories which had not been widely distributed throughout the Army. The TEC status level entry in Table 1 was used as a basis for selecting prospective lesson categories for inclusion in the study. The attempt was made wherever possible to select status level 3 or 4 materials. As can be seen from Table 1 however, this was accomplished only in the cases of the Artillery and Armor categories. In the cases of the other categories, many of the existing TEC lesson series were incomplete and therefore were inappropriate for inclusion in the present effort. In several situations, especially in the ADA category, many lessons were eliminated on the basis that they required extremely bulky and/or esoteric equipment and thus were not suitable candidates for inclusion in the study. Ease of transportation of the equipment was a major consideration in the overall experimental effort for which the present tests were to be employed as dependent variables.

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14 Knerr, et al., 1975, op. cit.

In several cases, the absolute number of TEC lessons in the content series was sufficiently large to preclude the development of a test which could be feasibly administered in field situations. For such lesson series, the test's length would be prohibitive if all reasonable TEC lesson content objectives were to be covered by the performance test. This constraint also effectively eliminated many TEC lessons from consideration.

Thus the actual selection of specific TEC lesson categories for inclusion in the study was severely constrained by the factors discussed. In the case of the Squad Radio selection, the choice was dictated by the fact that this was the only available TEC lesson series which was Infantry specific. Armor and Field Artillery selections were influenced particularly by the TEC status level (i.e., undistributed) character of the lessons. The ADA selection was singularly affected by equipment constraints and the common selection by the degree of performance orientation of the subject matter content.

TEST CONSTRUCTION

Format

The organization of the tests was similar to the format used in the Army SQT testing program. Each test was divided into administrative information and performance measures. Administrative sections included a foreword; an introduction describing the purpose of the test; references (doctrinal content validation); a description of the duties of testers; a description of required personnel, facilities and equipment; and instructions to examinees. The performance measures were grouped according to content. Each section identified as a Performance Measure Group was further divided into administrative information, and a section describing precisely how to administer the test.

Content Validation

The process of determining performance criteria on the basis of (information obtained directly from) job required skills defines a content valid criterion. Thus criterion-oriented tests which are derived from appropriate job/task/training analyses often provide the best available measure of performance objectives. No better criterion exists upon which to validate the instruments. A test may be considered to be content valid if the items are carefully based upon the performances, conditions and standards specified in the training objectives and if the test appropriately samples the objectives. Thus a careful test

construction process will, itself, go a long way toward establishing a content valid instrument.

In the present study, content validation was a two stage process. The first stage involved a series of systematic comparisons between the applicable content domains and the performance measure groups. Available Army literature and doctrine was thoroughly reviewed for each group. The technical content of the performance measures was defined by the content of the appropriate Army training literature and doctrine, as well as the content of the TEC lessons.

The second phase, a content review by Army experts, involved detailed discussions of each performance measure group; including required performances, applicable conditions and scoring standards, as well as administration feasibility and standardization of testing conditions. Content experts were noncommissioned officers who represented the relevant Army service school training departments in the appropriate content area.

The purpose of the content reviews was: to ensure that the content of each test was consistent with prevailing Army doctrine; to review the time limits set for specific performance measures; and to review the adequacy of the scoring requirements, administration requirements, testing conditions, standards for successful performance, and indicators of successful performance for each measure.

Following the content validation, performance measure groups were revised as appropriate based upon content expert comments. Typical revisions involved such areas as: time allocations for performance measures, revisions in the scoring standards, and more precise descriptions of desired behaviors on the part of examinees.

Tryout

Following the content validation and associated performance measure revision, an empirical tryout of each performance measure group was conducted. A simple chi-square approach which assessed performance measure score against an independent criterion of task mastery was used. Each performance measure was assessed in a 2 x 2 contingency table format which compared task masters (defined as soldiers who have completed AIT and regularly work in the task content area at appropriate Army Service schools) and non-masters (defined as basic trainees) against their performance measure score (GO, NO-GO). Each of the five performance tests was administered to an independent group of 40 soldiers (20 masters in

the area of test content - for example, M60 machinegun use, and 20 non-masters). A chi-square of less than 3.84 ($p<.05$, $df=1$) was considered to be sufficiently low to indicate that the performance measure did not discriminate adequately between masters and non-masters, and was therefore a candidate for revision. All such performance measures were thoroughly reviewed and appropriate content and/or scoring revisions made. Several performance measures were completely dropped from the tests as a result of this analysis. Based upon the content validation and performance measure tryout phases, final performance measures were selected.

Next, a test-retest reliability analysis was conducted. The same independent groups of 40 soldiers (for each of the five performance tests) were retested one day following the initial administration. Two separate analyses were performed on these data. First, Pearson correlation coefficients were computed on the test-retest data, yielding a basic index of test-retest reliability. Second, the t statistic was employed to assess the significance of the difference between the master and non-master mean score on the first test administration. A t of greater than 2.025 ($p<.05$, 38 df) was considered to be sufficient as to indicate that scores on the two mastery groups were significantly different.

Table 2 shows data resulting from the test tryouts. Test-retest correlation ranged from a high of .83 for masters on the Gunner's Quadrant test, to a low of .18 for non-masters on the M60 test. The t statistic shown in the third column of Table 2 provides information on the significance of the differences among means on the total test score (i.e., number of performance measures scored GO per test). All tests, with the exception of that on the Target Alert Data Display Set (TADDS), showed an ability to discriminate significantly between masters and non-masters on the first test administration. Discussion with content experts indicated that several of the TADDS performance measures were of sufficient difficulty to cause a substantial subset of masters to score NO GO. Also, the unit that provided the masters had not yet been issued the TADDS; therefore a number of the men classified as masters had little hands-on experience with the TADDS. This accounts in part for the lack of significance of the t statistic.

Final Versions of Tests

Following the tryouts, the performance tests were reviewed in light of the item statistics and test-retest indices. Final revisions were developed as appropriate to provide total test packages which were judged by all involved to accurately and reliably assess the performances required by the tests. Table 3

Table 2

PERFORMANCE TEST DEVELOPMENTAL RESULTS

Test	Masters Test-Retest Reliability Coefficients	Non-Masters Test-Retest Reliability Coefficients	Master Versus Non-Master Comparison on First Test Administration
M60	r = .48	r = .18	t = 11.4***
Squad Radio	r = .44	r = .38	t = 4.01***
M551	r = .63	r = .71	t = 2.78*
Gunner's Quadrant	r = .83	r = .49	t = 7.17***
TADDS	r = .70	r = .75	t = 1.47

*p < .05

***p < .001

gives the final set of performance test groups for each of the five performance tests.

The methodology discussed above resulted in a number of major changes in the five tests as described. Performance measures were revised on a variety of counts including: time requirements, clarity of instructions, order of administration, testing conditions, and adequacy of standards. Table 4 shows the numbers of performance measures in each content group as originally developed, and in the final version of the five tests. As is evident, drastic reductions, eliminations and/or regroupings occurred during the validation and tryout phases of test development.

ACTIVE COMPONENT EXPERIMENT

Sample

The AC was tasked to provide a total of 660 enlisted men with pay grade E5 or lower, 55 in each of 12 combat arms battalions. Three battalions were selected from each of the four combat arms (Infantry, Armor, Field Artillery and ADA). The sampled battalions were located at Fort Bliss in Texas, Fort Carson in Colorado and Fort Riley in Kansas.

Each Infantry battalion was tasked to provide 45 men with MOS 11B and 10 with MOS 11C; each Armor battalion was tasked for 16 men with MOS 11D and 39 with MOS 11E; each Field Artillery battalion was tasked for 49 men with MOS 13B and 6 with MOS 13E; each ADA battalion was tasked to provide 34 men with MOS 16P and 21 with MOS 16R. Within each combat arm, the number of men required for each MOS was proportioned to the number of men in those two MOS, in the total army.

Design

Each of the five selected lesson series was evaluated by dividing the subjects into five experimental groups. The five groups for each lesson series constitute a 2 x 2 factorial design with an added baseline control group.

The first experimental group was the TEC-with-LAI (TL) group. For each lesson category, the TL group took the Lesson Administrative Instructions (LAI) pre-tests, followed by the TEC lessons, followed by the pre-tests given again as post-tests. They were informed of the correct answers after both the pre- and post-tests. After administration of all lessons and LAI tests for the

Table 3

PERFORMANCE TEST WITH ASSOCIATED PERFORMANCE MEASURE GROUPS

Performance Test:	Performance Measure Groups:
M60 Machinegun (for use by all soldiers)	1. Demonstrate changing the barrel of the M60 machinegun to prevent overheating.
	2. Demonstrate the 3 assault positions for firing an M60 machinegun.
	3. Assume correct position and grip for firing a bipod emplaced M60 machinegun.
	4. Zero a bipod mounted M60 machinegun on target.
	5. Clear ammunition from an M60 machinegun.
	6. Perform a general disassembly of the M60 machinegun into its 8 groups.
	7. Perform assembly of an M60 machinegun so that it functions properly.
Performance Test:	**Performance Measure Groups:**
Use of the Squad Radio (for use by Infantry branch only)	1. Perform a preventive maintenance inspection.
	2. Assemble the transmitter and receiver.
	3. Perform an operation check with the squad radio.
	4. Check for a faulty radio or jamming.

(continued)

Table 3 (concluded)

Performance Test: Target Engagement, M551 Tank (for use by Armor branch only)	Performance Measure Groups: 1. Aligning the missile reticle. 2. Aligning the target and gun/launcher reticle. 3. Aligning the target and coax machinegun reticle. 4. Employing the coax machinegun against troops. 5. Determining range with the reticle.
Performance Test: Tube Artillery Tests of the Gunner's Quadrant (for use by Field Artillery branch only)	Performance Measure Groups: 1. Set quadrant values. 2. Perform a micrometer test. 3. Perform a positive end-for-end test. 4. Perform a negative end-for-end test.
Performance Test: Target Alter Data Display Set (TADDS) (for use by Air Defense branch only)	Performance Measure Groups: 1. Set up, energize, perform operation checks, and perform a march order for a TADDS. 2. General knowledge regarding set up and operation checks for a TADDS. 3. Using the TADDS. 4. Perform maintenance of the battery.

Table 4

RESULTS OF TEST REVISIONS

Task	Number of Performance Measures in Original Draft	Number of Performance Measures in Final Version
M60		
Performance Measure Group 1	3	2
Performance Measure Group 2	4	Eliminated
Performance Measure Group 3	4	3
Performance Measure Group 4	3	1
Performance Measure Group 5	11	3
Performance Measure Group 6	2	1
Perfromance Measure Group 7	2	1
Performance Measure Group 8	3	2
Squad Radio		
Performance Measure Group 1	13	4
Performance Measure Group 2	6	4
Performance Measure Group 3	2	2
Performance Measure Group 4	2	1
Performance Measure Group 5	7	Eliminated
M551		
Performance Measure Group 1	6	Eliminated
Performance Measure Group 2	3	1
Performance Measure Group 3	8	7
Performance Measure Group 4	4	3
Performance Measure Group 5	5	4
Performance Measure Group 6	4	3
Gunner's Quadrant		
Performance Measure Group 1	9	8
Performance Measure Group 2	5	4
Performance Measure Group 3	11	9
Performance Measure Group 4	12	10
TADDS		
Performance Measure Group 1	26	16
Performance Measure Group 2	14	6
Performance Measure Group 3	7	6
Performance Measure Group 4	14	4

category, the performance test for these lessons was given on the following day. The tests were administered by military personnel supervised by ARI and/or Litton Mellonics staff.

The second group was the TEC-Only (TO) group. This group received TEC instruction but without LAI testing or feedback.

The third group was the Conventional-with-LAI (CL) group. This group received conventional instruction but took the pre- and post-tests in the same manner as the TL group; that is, a set of pre-tests, followed by conventional instruction covering the same material as the corresponding TEC lessons, followed by the pre-tests given as post-tests. They were given the correct answers immediately after both the pre- and post-tests. Thus the pre- and post-testing procedure for the CL group was identical to that used for the TL group. The CL group received conventional instruction administered by personnel from the sampled battalions normally responsible for giving instruction. The instructors did not have access to the TEC lessons and lesson administrative instructions, but were given the information provided in the LAI for each relevant TEC lesson. This information consists of references and general lesson objectives.

The fourth group was the Conventional-Only (CO) group. This group received the same conventional instruction as the CL group, but without the LAI testing and feedback.

The fifth group was the Baseline (BL) group. In place of instruction, the soldiers in this group went about their normal military duties. On the following day they took the same performance test as the other groups.

This design allows evaluation of TEC vs. conventional instruction, LAI pre- and post-testing vs. no pre- and post-testing and the interaction of instruction mode with testing mode. The baseline group (BL) was included to allow correction for effects of prior training and also for the effect of the initial performance test on the retention test.

For four of the five lesson series evaluated, each experimental group was designed to contain 24 subjects, eight from each of three battalions in a single combat arm. For the M60 machinegun lesson series, each experimental group was designed to contain 36 subjects, three from each of the twelve sampled AC battalions.

Between eight and nine weeks after the initial training and testing, the performance test for each lesson series was readministered to as many of the initially tested subjects as could be obtained. For purposes of retention analyses, the only

scores used were those for subjects who indicated no training of any kind in the relevant subject area between initial testing and retention testing.

Procedures

Each battalion visited was tasked at least one month prior to the visit to provide 55 men and four instructors. Each unit was told to task the instructor in the normal manner for that unit. Two of the instructors were to provide MGO machinegun instruction, one for the CL group, the other for the CO group. The other two provided instruction in the subject area selected for that particular combat arm. The instructors were provided with lesson objectives and references as given in the LAIs for the TEC lessons covering that subject area, but they were specifically instructed not to view the TEC lessons (if available) for that subject. The information provided to instructors is given in Appendix A.

At the beginning of the visit to a battalion, the 55 subjects were randomly divided into ten groups, five groups of eight subjects for the combat arm-specific instruction and five groups of three each for the M60 machinegun instruction. Both TEC and conventional instruction were then given during the initial day of the visit. Both the TEC and conventional instruction subjects were provided with any necessary equipment (gunner's quadrants, machineguns, etc.) for use during instruction.

On the second day of the visit, the procedure called for each of the 55 subjects to be given a hands-on performance test, 40 subjects receiving the combat arm-specific test and 15 the M60 machinegun test; however, in some units a few soldiers were unavailable for testing. No feedback was given to subjects at this time as to their performance on the tests. The tests were administered by enlisted personnel from Army Training Centers specifically trained for that purpose. The same team of testers administered the tests for the two subject areas in all three battalions of a given combat arm. Between eight and nine weeks later the testing team returned to readminister the performance tests during a one-day visit to each battalion. The sampled units were asked to provide the GT scores of all initially tested subjects at the time of the revisit.

Prior to both the initial performance test and the retention test, each subject completed a brief questionnaire. For the initial test, the subjects provided name, rank, MOS, time in service and information on prior training (TEC or other) pertaining to the subject of the performance test. For the retention test, each subject indicated whether he received any

type of training in the relevent subject area between the dates of the initial and retention tests. Examples of the two questionnaires are given in Appendix C.

Results

Scoring Method. Each performance test was scored in two ways. First, the percent of performance measures on which the subject received a GO was determined for each subject. Second, the percent of performance measure groups on which the subject received a GO was determined for each subject. A subject was given a GO for a performance measure group if he obtained a GO on each measure in the group. The results were essentially the same under both scoring methods, hence results for only the first method will be presented here.

Initial Performance Test. Table 5 gives the mean and standard error for the percent of items scored GO on for the initial perfomance test in each subject area, along with the sample sizes. A 5x3 analysis of variance (ANOVA) was performed on the data from each of the four combat arms-specific subject areas (experimental groups by sampled battalion). For the M60 machinegun data a 5x4 ANOVA was performed (experimental groups by combat arm). For none of the four combat arm-specific subjects was there a significant battalion effect or a significant interaction between battalions and experimental groups ($p>.05$ in all cases). For the M60 machinegun data, the combat arm effect was significant but the interaction was not significant. The significant combat arm effect is due to the fact that the M60 testers for Field Artillery battalions administered the performance measure group on barrel change under a different initial condition than in the other combat arms. The Field Artillery testers put the M60 bolt to the rear instead of forward prior to having subjects attempt the barrel change. This makes passing the two measures in the group much easier. When the combat arms are compared with the barrel change items eliminated, the combat arm effect is no longer significant ($p > .05$)

The experimental group effect was broken into four independent contrasts for each subject area. These compared TEC to conventional instruction, LAI testing to no LAI testing, the interaction (i.e., TL-TO-CL+CO) and the BL mean to the mean of the other four groups combined. For all five subject areas, the effect of LAI testing was not significant ($p > .05$) while the difference between the BL mean and the mean of the other groups was significant ($p < .001$). The instruction effect was significant for M551 ($p < .001$) TADDS ($p = .01$) and M60 ($p < .001$) but not for Squad Radio ($p = .55$) and Gunner's Quadrant ($p = .10$).

Table 5

AC INITIAL PERFORMANCE TEST RESULTS

Test		Experimental Group TL	TO	CL	CO	BL
M60	mean % scored GO	57.7	54.5	42.6	42.8	12.7
	standard error of mean [a]	3.3	3.5	4.2	4.0	2.1
	sample size	34	35	35	34	37
Squad Radio	mean % scored GO	69.5	62.8	65.0	63.3	45.5
	standard error of mean	4.0	4.1	3.2	3.0	3.8
	sample size	20	24	21	23	22
M551	mean % scored GO	52.9	52.8	40.5	35.9	32.7
	standard error of mean	3.6	2.9	3.0	2.4	2.7
	sample size	23	24	24	24	27
Gunner's Quadrant	mean % scored GO	31.3	25.9	28.1	43.2	8.3
	standard error of mean	4.6	4.5	3.9	4.8	3.2
	sample size	24	24	24	25	24
TADDS	mean % scored GO	73.5	71.7	64.8	61.8	36.7
	standard error of mean	5.5	3.6	2.3	3.0	3.8
	sample size	19	22	19	24	23
Average	mean % scored GO	57.0	53.5	48.2	49.4	27.2

[a] M60 standard errors are corrected for differences among combat arms.

The interaction between instruction and LAI testing was significant only for Gunner's Quadrant. As can be seen in Table 5, this interaction is due to the superior performance of the CO group relative to the other three.

GT Score Findings. GT scores for the sampled soldiers have been provided by all but one battalion (Armor). Table 6 gives the mean GT score and the correlation between GT and performance test scores for each experimental group in the five subject areas. Because of the missing battalion, the M60 and Armor statistics are based on less than the full sample. Recall that Knerr et al.[15] found positive correlations for their AC Conventional Instruction groups but near-zero correlations for the AC TEC groups. This result was not replicated here.

For the Gunner's Quadrant subjects, the mean GT score of the CO group was high in comparison to the other experimental groups. For this reason, an Analysis of Covariance (ANCOVA) was done on the performance test scores using GT score as the covariate. The intent of the analysis was to determine if the significant interaction between LAI testing and type of instruction is accounted for by the variation in GT scores. The ANCOVA showed an insignificant interaction ($p = .094$) along with insignificant main effects.

Retention Test. Table 7 gives initial and retest results for that portion of the sample on which retest scores were obtained. Only soldiers with no training intervening between the two administrations of the performance test are included in Table 7. As will be noted from the sample sizes given in the table, only 56 percent of the initial sample is included in the retest results. Of the soldiers initially tested, 35 percent were unavailable for retesting and 9 percent were eliminated because of intervening training. Nonetheless initial test results for the retested portion of the sample are quite close to the results for the total sample.

The same set of planned comparisons reported above for the full sample was carried out on both the initial test and retest data for the retested subsample. The statistically significant effects for the initial test data in the subsample were the same as those found for the full sample. The retest results duplicated those for the initial test with two exceptions -- for Squad Radio the method of instruction effect was significant ($p < .01$) and the BL mean did not differ significantly from the mean of the other four groups ($p = .66$).

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15 Knerr, et al., 1975, op. cit.

Table 6

AC MEAN GT SCORE AND CORRELATION (r) BETWEEN GT AND PERFORMANCE TEST SCORE

Test		Experimental Group				
		TL	TO	CL	CO	BL
M60	Mean	107.8	101.1	99.0	104.6	100.9
	r[a]	-.02	.22	-.36*	-.14	.03
	N	31	34	33	32	35
Squad Radio	Mean	104.5	104.6	109.2	100.1	100.7
	r	.27	-.17	.11	-.21	.33
	N	20	24	19	21	20
M551	Mean	97.6	98.8	99.1	98.6	102.6
	r	.42	-.06	-.05	.27	-.06
	N	10	12	12	11	20
Gunner's Quadrant	Mean	103.5	99.4	100.8	108.9	101.5
	r	.53*	.20	.10	.46*	.36
	N	22	24	22	24	22
TADDS	Mean	102.2	98.3	101.9	96.2	98.6
	r	.36	.23	.59**	.02	-.31
	N	16	21	18	21	23

[a] M60 r corrected for differences among Combat Arms

* $p < .05$

** $p < .01$

Table 7

AC INITIAL AND RETENTION TEST MEAN PERCENT SCORED GO
FOR THE RETESTED SUBSAMPLE

Test		Experimental Group				
		TL	TO	CL	CO	BL
M60	initial test	59.6	54.3	43.6	33.3	15.4
	retention test	56.9	46.6	42.9	37.9	21.7
	subsample size	20	17	21	15	17
Squad Radio	initial test	62.0	66.4	67.7	63.1	50.8
	retention test	70.7	68.2	51.2	61.5	65.4
	subsample size	9	14	11	13	10
M551	initial test	51.8	52.4	38.3	37.2	32.7
	retention test	50.0	54.0	41.7	40.6	37.7
	subsample size	9	14	18	13	19
Gunner's Quadrant	initial test	37.6	24.8	28.8	43.7	11.0
	retention test	28.3	20.6	28.0	38.0	20.7
	subsample size	9	16	15	18	12
TADDS	initial test	79.9	71.6	64.7	61.8	33.7
	retention test	72.1	67.5	60.5	57.6	39.8
	subsample size	12	10	14	14	15
Average	initial test	58.2	53.9	48.6	47.8	28.7
	retention test	55.6	51.4	44.8	47.1	37.1

In order to determine whether there were differences in retention among the experimental groups in each subject area, an ANCOVA using the initial test score as the covariate was done on the retest scores in each subject area. The only significant effect in all five ANCOVAs was the type of instruction effect for the Squad Radio ($p < .02$). The Squad Radio TEC groups showed significantly greater retention than the conventional instruction group.

Application of Learning Model. Note that for every subject area in Table 7, the mean retest baseline score is higher than the mean initial test score. This is most likely due primarily to learning occurring as a result of the initial test. Since this same type of learning occurs for subjects in the four groups receiving training, it is desirable to correct the retention scores for this effect. To this end, a simple learning model was applied to the data which allows correction of initial test scores for the effect of training prior to the experiment and correction of retest scores for the effect of both prior training and initial testing. The model involves a slight extension of traditional "correction for guessing" procedures.[16]

Basically, it is assumed in the model that on the initial test, soldiers receive a "GO" on a performance test item for one of two reasons. First, the correct response to some proportion of the test items, P(K), is known as a result of prior training and/or experience. Second, the correct response to some proportion, P(L), of the remaining items is learned through training given in the experiment. That is, $P(G) = P(K) + P(L)[1 - P(K)]$ where P(G) is the proportion of items scored GO on the test. Solving for P(L),

$$P(L) = \frac{P(G) - P(K)}{1 - P(K)}.$$

In other words, since 1 - P(K) is the proportion of items not known through prior training or experience, P(L) is that proportion of these unknown items learned through training given in the experiment. P(L) can be estimated from the data by assuming that the proportion of items scored "GO" for the baseline group, P(BL), is an estimate of P(K). Under this assumption,

$$P(L) = \frac{P(G) - P(BL)}{1 - P(BL)}. \qquad (1)$$

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16 Woodworth, R.S. Experimental psychology. New York: Henry Holt and Co., 1938.

For the retest, it is assumed in the model that there are three ways to receive a GO on an item. First, the item may be known through prior training and/or experience. Second, the item may be learned during training given in the experiment and retained over the period between the intital test and the retest. Third, the item may be learned during the initial test and retained until the retest. Under the assumption that the proportion of items scored GO for the baseline group on the retest P(BL′), reflects both prior training (and/or experience) and information acquired during the initial test, an estimate can be obtained for P(L′), the proportion of the initially unknown items learned in experimental training and retained until the retest. It can be shown that

$$P(L') = \frac{P(G') - P(BL')}{1 - P(BL')}. \qquad (2)$$

Finally, by taking the ratio of P(L) and P(L′), an estimate is obtained for P(R), the proportion of those items learned during experimental training that were retained until the retest. That is,

$$P(R) = \frac{P(L')}{P(L)}. \qquad (3)$$

A more complete presentation of the model is given in Appendix C.

For each of the four training groups in each subject area, equations 1, 2, and 3 were used to estimate P(L), P(L′) and P(R). These estimates are given in Table 8. Note that for Squad Radio, M551 and TADDS, P(R) is larger for the TL and TO groups than for the CL and CO groups. The reverse is true for Gunner's Quadrant, while for M60 the retention measures are somewhat equivocal. The absence of any retention for the Squad Radio conventional instruction groups is inferred from the fact that the performance of these two groups on the retention test fell below the level of the BL group, leading to negative parameter estimates.

By treating the five subject areas as a random sample from the set of all subject areas for which TEC lessons have been developed, it is possible to average the parameter values across subject areas and then test these means for differences among the experimental groups. While the subject areas were not actually randomly sampled, the statistical tests give some feel for the extent to which differences among the experimental groups for these five subject areas can be generalized to the set of all Combat Arms subject areas. The statistical approach used for each parameter was a 2x2 ANOVA (method of instruction by presence or

Table 8

AC PROPORTIONS ESTIMATED FROM LEARNING MODEL

Test		Experimental Group TL	TO	CL	CO
M60	P(L)	.523	.460	.333	.212
	P(L′)	.450	.318	.270	.207
	P(R)	.860	.691	.810	.977
Squad Radio	P(L)	.228	.317	.343	.249
	P(L′)	.152	.079	0[a]	0[a]
	P(R)	.668	.249	0	0
M551	P(L)	.284	.292	.082	.066
	P(L′)	.197	.261	.063	.046
	P(R)	.694	.894	.772	.701
Gunner's Quadrant	P(L)	.299	.155	.200	.368
	P(L′)	.096	0[a]	.092	.218
	P(R)	.321	0	.458	.593
TADDS	P(L)	.697	.571	.468	.424
	P(L′)	.537	.460	.344	.295
	P(R)	.770	.806	.735	.697
Average	P(L)	.406	.359	.285	.264
	P(L′)	.286	.224	.154	.153
	P(R)	.663	.528	.555	.594

[a] Negative estimate set at 0.

absence of pre- and post-testing) in which all effects were treated as within-subject area effects, with a single pooled error term used to form all F-ratios.[17]

For the P(L) parameter, the effect of method instruction was statistically significant ($p < .05$), indicating that on the average, TEC instruction produces more learning than conventional instruction. Neither the pre- and post-testing effect nor the interaction between instruction and testing were significant ($p > .05$ in both cases). The method of instruction effect was also significant for the P(L′) parameter ($p < .05$), indicating that after an eight week interval TEC instruction maintains an advantage over conventional instruction. Again, no other effects were significant ($p > .05$). For the P(R) parameter there were no significant effects of any kind ($p > .05$ in all cases). This means that the proportion of learned material lost over the eight week retention interval is not significantly different for TEC and conventional instruction. In summary, the evidence is that more is learned through TEC instruction than through conventional instruction, but that forgetting of the learned material occurs at about the same rate for the two approaches.

Since more is learned initially through TEC and forgetting rates are the same, TEC should show an advantage over conventional instruction at any retention interval. This prediction is graphically illustrated in Figure 1 of the Executive Summary. The points plotted at zero and eight weeks are respectively the P(L) and P(L′) estimates for each experimental group. An exponential curve asymptoting at zero is fitted to each pair of points as a simple approximation to the likely shape of the retention curve.

Questionnaire Information. Recall that prior to taking the initial performance test, each soldier completed a brief questionnaire. The responses to the items on the questionnaire are given in Appendix D. Information was also gathered from the four individuals in each battalion tasked to give conventional instruction. This information is summarized in Appendix E.

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17 Winer, B. J. Statistical principles in experimental design. (2d ed.) New York: McGraw-Hill, 1971.

NATIONAL GUARD EXPERIMENT

Sample

The RC was tasked to provide a total of 660 National Guard (NG) soldiers, 55 in each of 12 combat arms battalions. These battalions were selected from each of the four combat arms. The three ADA battalions were part of the 200th ADA Group in New Mexico. The other nine battalions were from the 50th Armored Division in New Jersey. With the exception of the ADA battalion, the battalions were tasked for the same MOS's in the same numbers as the AC. Since the sampled ADA battalions had no men in MOS 16P and 16R, the men provided were instead primarily in MOS 16F.

Due to a short-fall in the numbers of soldiers participating in the experiment for the Field Artillery units, a fourth NG battalion was added to the study. This battalion was part of the 118th Field Artillery Group in Georgia.

Design and Procedures

The design of the RC experiment was identical to the AC design. The procedure was also essentially the same except for greater variability in the RC test-retest interval. Each sampled battalion was retested two drill after the initial test. Since the weekend drill schedules for the sampled units were set well in advance of the initial training and testing visit, the test-retest interval could not be held constant. The intervals ranged from eight to thirteen weeks.

The performance tests for Infantry and Armor battalions were administered by NCO's from the test section of the 78th Training Division in New Jersey. The ADA testers came from the 111th ADA Brigade in New Mexico. Two of the testers for Field Artillery battalions were enlisted men assigned to the ARI field unit at Fort Benning, GA. Three others came from a Field Artillery battalion attached to the 78th Training Division. All performance testers were given training in administration of the tests by ARI and/or Litton Mellonics personnel.

In some of the sampled NG battalions, circumstances resulted in departure from the standard procedure. Due to a concurrent scheduled exercise, it was necessary to do the initial testing in one of the Armor battalions on the same day as the training. One of the Infantry battalions did not provide the necessary number of squad radios; as a result of this, the TL and TC groups did not have radios for use during the TEC training. In one ADA battalion, the LAI post tests were not administered due to a lack

of time before the men were released for the day. In a number of units, the M60 machineguns were provided without bolts. A tester shortage required either the ARI or Litton Mellonics representative to serve as a tester for two of the thirteen initial visits and for six of the thirteen retest visits.

Results

Initial Performance Test. Table 9 gives the results for the initial performance test in each subject area. The same experimental group-by-battalion ANOVA used in the AC experiment was performed on the NG data. The only subject area for which there were no significant differences ($p>.05$) among battalions (combat arms for M60) was the TADDS. For none of the subject areas was the interaction between battalions and experimental groups significant ($p>.05$ in all cases).

As in the AC analyses, the experimental group effect was broken into four independent contrasts. The difference between TEC and conventional instruction was significant for M60 ($p<.001$) and M551 ($p<.01$). The difference between instruction with and without LAI pre- and post-testing was significant for M60 ($p<.001$) and Squad Radio ($p<.05$). As can be seen in Table 9, the Squad Radio groups receiving no LAI testing did better than those that were tested. There were no cases of a significant interaction between method of instruction and LAI testing ($p>.05$ for all subject areas). The difference between the BL mean and the mean of the other four groups was significant for all five subject areas ($p<.05$ for M551, $p<.001$ for the others).

GT Score Findings. Only partial data were available on GT Scores for the NG sample. Of the thirteen NG battalions sampled, two Infantry, three Armor, one Field Artillery and one ADA battalion have provided GT Scores. The GT scores were unavailable for a number of the men in those battalions supplying scores. For only two of the subject areas, M60 and M551, were enough data provided to look at the correlation between initial performance test scores and GT scores, and then only by combining the TL with TO data and the CL with the CO data. The results are given in Table 10. As in the AC sample, there is no evidence of a lower correlation for TEC-trained soldiers than for conventionally trained soldiers. In fact, for M60 the TEC correlation is significantly higher than the conventional correlation ($p<.05$).

Retention Test. Table 11 gives initial and retest results for that portion of the NG sample on which retest scores were obtained. As with the AC sample, only soldiers with no training intervening between the initial and retention test are included in Table 11. Only 51 percent of the initial test sample is included

Table 9

NG INITIAL PERFORMANCE TEST RESULTS

Test		Experimental Group TL	TO	CL	CO	BL
M60	mean % scored GO	71.4	55.8	47.4	33.0	24.9
	standard error of mean[a]	3.3	4.8	3.7	3.2	3.5
	sample size	29	32	32	28	29
Squad Radio	mean % scored GO	74.8	81.8	69.7	78.4	54.5
	standard error of mean[a]	4.3	2.8	2.8	2.8	4.8
	sample size	22	20	21	19	19
M551	mean % scored GO	47.7	45.4	37.7	36.4	30.1
	standard error of mean[a]	3.9	4.3	2.9	2.8	3.2
	sample size	22	18	19	18	12
Gunner's Quadrant	mean % scored GO	54.7	46.9	46.6	48.5	11.0
	standard error of mean[a]	5.0	4.8	5.6	4.1	2.0
	sample size	21	22	24	21	22
TADDS	mean % scored GO	69.4	63.7	70.3	71.3	35.1
	standard error of mean	4.3	3.6	3.4	3.3	3.7
	sample size	18	19	16	18	18
Average	mean % scored GO	63.6	58.7	54.4	53.6	31.1

[a] Standard errors are corrected for differences among battalions.

Table 10

NG MEAN GT SCORE AND CORRELATION (r) BETWEEN
GT AND PERFORMANCE TEST SCORE

Test		Experimental Group		
		TL+TO	CL+CO	BL
M60	Mean	104.8	98.8	106.6
	r[a]	.59**	-.16	.04
	N	20	22	13
M551	Mean	104.2	108.1	116.3
	r[b]	.37	.09	-.07
	N	26	25	11

[a] M60 r corrected for differences among Combat Arms

[b] M551 r corrected for differences among battalions

** $p < .01$

Table 11

NG INITIAL AND RETENTION TEST MEAN PERCENT SCORED GO FOR THE RETESTED SUBSAMPLE

Test		Experimental Group TL	TO	CL	CO	BL
M60	initial test	76.2	69.8	55.4	38.5	28.9
	retention test	65.4	58.8	55.9	43.9	35.3
	subsample size	10	14	15	7	17
Squad Radio	initial test	84.1	82.6	70.9	81.8	60.0
	retention test	84.1	71.9	89.1	76.7	64.6
	subsample size	4	11	5	9	10
M551	initial test	54.2	47.7	42.4	38.9	32.7
	retention test	54.6	58.8	43.8	41.7	45.2
	subsample size	12	12	8	14	8
Gunner's Quadrant	initial test	56.6	44.9	45.9	46.3	8.1
	retention test	43.9	32.0	38.5	34.8	11.6
	subsample size	13	13	13	14	10
TADDS	initial test	71.0	68.8	69.6	73.7	29.8
	retention test	65.1	63.6	66.1	70.1	47.1
	subsample size	11	9	15	12	11
Average	initial test	68.4	62.8	56.8	55.8	31.9
	retention test	62.6	57.0	58.7	53.4	40.8

in the retention test results. Of those soldiers given the initial test, 39 percent were unavailable for retesting and 10 percent were eliminated because of intervening training. The Squad Radio retest sample is particularly small, including only 39 percent of the initial sample. With the exception of the M60 TO group and the Squad Radio TL group, initial test results for the retested soldiers are close to the results for the complete sample.

As with the AC sample, the initial test analyses done on the full NG sample were also carried out on the retested subsample. The results of the subsample analyses were the same as those for the full sample, with four exceptions: The M60 LAI testing effect was not statistically significant for the subsample, the Squad Radio Battalion and LAI testing effects were not significant and the M551 instruction effect was not significant ($p > .05$ in all cases). The analyses carried out on the retest data showed significant differences among combat arms for the M60 retest ($p < .01$), a significant instruction effect for the M551 retest ($p < .01$) and a significant LAI testing effect for the Squad Radio retest ($p < .05$). Also, the BL group mean was significantly less than the mean across the other four group for all but the M551 retest ($p < .001$ for TADDS, $p < .01$ for M60 and Gunner's Quadrant and $p < .05$ for Squad Radio). There were no other statistically significant results. As can be seen in Table 11, the Squad Radio LAI testing effect is in favor of instruction with pre- and post-testing. This is in contrast to the initial test result for the full sample which was in favor of instruction without pre- and post-testing. Note that the LAI testing result on the retest is due primarily to the fact that the mean retest score for the five retested soldiers in the Squad Radio CL group is over 18 percent above their initial test mean.

Retest data for each performance test were analyzed with an ANCOVA, using initial test score as the covariate. Recall that this type of ANCOVA essentially analyzes the differences among the experimental groups in the change in performance test score from the initial to the retention test. For the M551 test, TEC instruction showed significantly better retention than conventional instruction ($p < .05$) and the sampled battalions differed significantly ($p < .05$). For the Squad Radio test, LAI testing resulted in significantly better retention than no LAI testing ($p < .05$) and again the battalions differed significantly ($p < .05$). The significant LAI testing effect can again be attributed primarily to the 18 percent increase in the CL group mean score from the initial to the retention test. The ANCOVAs yielded no other statistically significant effects.

Application of Learning Model. The mean NG performance test scores were corrected for the effects of prior experience and testing using the same model that was applied to the AC means. Estimates of the parameters P(L), P(L′) and P(R) are given in Table 12. Note that for the Squad Radio CL group and the M551 TO group, the estimate of P(L′) has been set equal to the corresponding P(L) estimate. According to the underlying model, P(L′) is equal to P(L) [1-P(R)] and hence cannot be greater than P(L); however, it is possible for the empirical estimate of P(L′) to exceed the estimate of P(L). This was the case for the Squad Radio and M551 estimates mentioned. A review of the data in Tables 9 and 11 indicated that for the two groups in question, it is likely that the estimate of P(L′) is greater than the P(L) estimate because P(L′) was overestimated rather than P(L) being underestimated. For this reason, the P(L′) estimate was decreased to the value of the P(L) estimate.

Treating the five subject areas as a random sample from the set of all subject areas covered by TEC lessons, the parameter estimates in Table 12 were taken as input to three ANOVAs, as was done for the AC sample. For the P(L) estimate, the only statistically significant effect was the effect of type of instruction, with TEC instruction being significantly better than conventional ($p < .05$). The ANOVA for P(L′) resulted in no significant effects. However, on closer examination, the mean P(L′) estimate for the TL group was found to be significantly greater than the combined mean of the estimates for the other three groups ($p < .05$). No significant effects of any kind were found in the ANOVA for P(R).

Questionnaire Information. Responses of NG soldiers to items on the questionnaire completed prior to the initial performance test are summarized in Appendix F. Information on the individuals providing conventional instruction is given in Appendix G. others).

Table 12

NG PROPORTIONS ESTIMATED FROM LEARNING MODEL

Test		Experimental Group TL	TO	CL	CO
M60	P(L)	66.5	57.5	37.2	13.4
	P(L')	46.5	36.3	31.9	13.3
	P(R)	70.0	63.1	85.6	99.2
Squad Radio	P(L)	60.2	56.6	27.3	54.6
	P(L')	55.1	20.8	27.3[a]	34.4
	P(R)	91.5	36.7	100.0	63.0
M551	P(L)	31.9	22.3	14.4	9.2
	P(L')	17.2	22.3[a]	0[b]	0[b]
	P(R)	53.9	100.0	0	0
Gunner's Quadrant	P(L)	52.8	40.1	41.2	41.6
	P(L')	36.6	23.1	30.4	26.3
	P(R)	69.3	57.6	73.8	63.1
TADDS	P(L)	58.7	55.5	56.7	62.5
	P(L')	33.9	31.1	35.8	43.4
	P(R)	57.8	56.0	63.2	69.5
Average	P(L)	54.0	46.4	35.4	36.3
	P(L')	37.9	26.7	25.1	23.5
	P(R)	68.5	62.7	64.5	59.0

[a] Estimate reduced to theoretical maximum of P(L).
[b] Negative estimate set at 0.

REFERENCES

Knerr, Claramae S., Downey, Ronald G. and Kessler, John J. Training individuals in Army units: Comparative effectiveness of selected TEC lessons and conventional methods. ARI Research Report 1188. December 1975.

Mays, P. V., Holmgren, J. E. and Shelnutt, J. B. Current use, patterns of use and factors affecting use of the Army Training Extension Course (TEC) Program. ARI Technical Report TR-79-A3, May 1979.

McClusky, Michael R. and Tripp, James M. An evaluation of the utilization, maintenance and perceived benefits of the Training Extension Course (TEC) (Tech, Rep. 75-18). Alexandria, VA: Human Resources Research Organization, June 1975.

Temkin, Sanford, Conolly, J. A., Marvin, M. D., Valdes, A. L. and Caviness, J. A. A cost assessment of Army training alternatives. ARI Research Problem Review 75-3. August 1975.

Winer, B. J. Statistical principles in experimental design. (2d ed.) New York: McGraw-Hill, 1971.

Woodworth, R. S. Experimental psychology. New York: Henry Holt and Co., 1938.

APPENDIXES

APPENDIX A INSTRUCTOR INFORMATION

Information for M60 Instructors

Subject: M60 Machinegun Mechanical Training, Firing and Zeroing

Training Time: Approximately three hours.

Training Objectives: Soldiers completing this instruction should be able to:

a. Clear the M60 machinegun.
b. Disassemble the M60 into its major groups and assemblies.
c. Inspect the M60.
d. List the common defects of the weapon.
e. Assemble the M60.
f. Perform a function check on the M60.
g. Identify the correct position and grip for firing the M60 on its bipod and tripod.
h. Demonstrate the three assault positions when firing an M60 machinegun.
i. Calculate deflection correction.
j. List the weapon's three rates of fire and when the barrel should be changed for each.

References: FM 23-67, TM 9-1005-224-10, TM 9-1005-224-24

1. The above references contain information on all of the above objectives. Any additional references may be used with the exception of the TEC lessons on the M60 machinegun. It is extremely important that instructors do not view these TEC lessons in preparing their instruction.

2. Each instructor will train a group of three soldiers. M60 machineguns for use during training may be obtained from the armory.

INFORMATION FOR SQUAD RADIO INSTRUCTORS

SUBJECT: Introduction to and Operation of the Squad Radio

TRAINING TIME: Approximately two hours.

TRAINING OBJECTIVES: Soldiers completing this instruction should be able to;

a. Identify the component parts.

b. Plan battery life.

c. Identify and operate the controls properly.

d. Identify the planning range.

e. Perform operator maintenance.

f. Assemble the Squad Radio correctly.

g. Operate the Squad Radio.

h. Identify jamming signals and take corrective action.

i. Recognize malfunctions and identify corrective action to be taken.

REFERENCES: TM 11-5820-549-12.

1. The above reference contains information on all of the above objectives. Any additional references may be used, with the exception of the TEC lessons on Squad Radio. It is extremely important that instructors do not view these TEC lessons in preparing their instruction.

2. Each instructor will train a group of eight soldiers. Squad Radios for use during training will be made available by the battalion.

INFORMATION FOR M551 TARGET ENGAGEMENT INSTRUCTORS

SUBJECT: Center of target vulnerability, aligning the reticle and determining range: M551 Gunner.

TRAINING TIME: 1 hour 15 minutes.

TRAINING OBJECTIVES: Soldiers completing this instruction should be able to:

a. Identify center of target mass

b. Distinguish correctly and incorrectly aligned reticles

c. Correctly align the conventional reticle and determine range

REFERENCES: FM 17-12

1. The above reference containes information on all of the above objectives. Any additional references may be used, with the exception of the TEC lessons on M551 Target Engagement. It is extremely important that instructors do not view these TEC lessons in preparing their instruction.

2. Each instructor will train a group of eight soldiers. Instructors may obtain any equipment they wish for use during training.

INFORMATION FOR GUNNER'S QUADRANT INSTRUCTORS

SUBJECT: Tube Artillery: Tests of the Gunner's Quadrant

TRAINING TIME: Approximately two hours.

TRAINING OBJECTIVES: Soldiers completing this instruction should be able to;

a. Set quadrants.

b. Use the gunner's quadrant for high-angle fire.

c. Perform the micrometer test.

d. Perform the end-for-end test with a positive correction.

e. Perform the end-for-end test with a negative correction.

REFERENCES: TM 9-2300-216-10, FM 6-88.

1. The above references contain information on all of the above objectives. Any additional references may be used, with the exception of the TEC lessons on the Gunner's Quadrant. It is extremely important that instructors do not view these TEC lessons in preparing their instruction.

2. Each instructor will train a group of eight soldiers. Gunner's Quadrants for use during training will be made available by the battalion.

INFORMATION FOR TADDS INSTRUCTORS

Subject: TADDS Emplacement, Operation and Maintenance

Training Time: Approximately two hours

Training Objectives: Soldiers completing this instruction should be able to:

a. Select a site for TADDS.
b. Tune and install the antenna.
c. Deploy the ground planes.
d. Energize the TADDS.
e. Perform a march order for TADDS.
f. Perform a battery voltage check.
g. Perform a self-test check.
h. Prepare for a radar check.
i. Perform a voice check.
j. Perform a radar check.
k. Orient the TADDS.
l. Plot the FAAR and fire unit locations on the TADDS display.
m. Respond to a TADDS alarm.
n. Perform "plot and tell" on the TADDS display.
o. Perform preventive maintenance on the TADDS.
p. Charge the battery.
q. Replace the battery.

References: FM 44-6, TM 9-1430-589-12

1. The above references should have been received by your unit from Ft. Bliss. Any additional references may be used, with the exception of the TEC lessons on TADDS. It is extremely important that instructors do not view these TEC lessons in preparing their instruction.

2. The references given above contain information on all of the above objectives except objective n (Perform "plot and tell" on the TADDS display). The attached pages provide that missing information.

3. Each instructor will train a group of eight soldiers. Eight TADDS for use during training will be provided by ARI.

APPENDIX B SOLDIER QUESTIONNAIRES

Name_____

SSAN_____

Primary MOS_____

Pay Grade_____

Time in Service _____Years _____Months

1. Had you ever seen any of the TEC lessons on the M60 before yesterday? Yes_____ No_____

If "yes", when did you last view these lessons? _____

2. Did you receive any training on M60 during BCT? Yes_____ No_____

3. Did you receive any training on M60 during AIT? Yes_____ No_____

4. Have you had any training on M60 since AIT? Yes_____ No_____

NAME _____

SSAN _____

UNIT _____

1. Have you viewed any of the TEC lessons on the M60 machinegun since you last took this test? Yes ____ No ____

2. Have you received any type of training on the M60 machinegun since you last took this test? Yes ____ No ____

3. Have you studied any manuals on the M60 machinegun since you last took this test? Yes ____ No ____

APPENDIX C LEARNING MODEL

The following is a simple model of the learning and retention processes in the TEC training effectiveness experiments. The model is formulated in terms of five states of knowledge and the probabilities of transition among the states at successive stages in the experiment. A soldier's level of knowledge about any given item on a performance test is assumed to be in exactly one of these five states at any given point in time. Transitions among the states are represented by transition matrices, each of which gives the probability that knowledge about an item will go from any one state to any other state at a given stage of the experiment.

STATE DEFINITIONS

State K: The correct response to a performance test item in this state is known as a result of general knowledge and/or training received prior to the experiment. Items in this state are not subject to forgetting.

State LT: The correct response to an item in this state has been learned through training provided in the experiment. Additional information about the item (making it more resistant to forgetting) has been acquired during the initial performance test.

State L: The same as State LT, except that no additional information has been acquired during the initial performance test.

State T: The correct response to an item in this state has been learned during the initial performance test. No information has been acquired through experimental training.

State U: The correct response to an item in this state is unknown.

START VECTOR

All items are assumed to be in either State K or State U at the beginning of the experiment. The probability of beginning in State K is k. These assumptions can be represented by the following vector $\underset{\sim}{s}$:

$$\begin{array}{cccccc} & K & LT & L & T & U \\ \underset{\sim}{s} = & (k & 0 & 0 & 0 & 1-k) \end{array}$$

TRAINING TRANSITION MATRIX

The matrix $\underset{\sim}{A}$ below gives the probability of an item moving from any state to any other state during training provided in the experiment. It is assumed that the only change of state that can occur is from State U to State L. The labels on the left of the matrix give the state at the beginning of training. The labels on the top give the state at the end of training.

$$\underset{\sim}{A} = \begin{array}{c} \\ K \\ LT \\ L \\ T \\ U \end{array} \begin{array}{c} \begin{array}{ccccc} K & LT & L & T & U \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & \ell & 0 & 1-\ell \end{bmatrix} \end{array}$$

INITIAL TESTING TRANSITION MATRIX

After training an item could be in State K, State L or State U. It is assumed that an item in State U can be learned during testing and move to State T. Additional information can be acquired about an item in State L, moving the item into State LT. In either case, the probability of changing state is assumed to be t.

$$\underset{\sim}{B} = \begin{array}{c} \\ K \\ LT \\ L \\ T \\ U \end{array} \begin{array}{c} \begin{array}{ccccc} K & LT & L & T & U \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & t & 1-t & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & t & 1-t \end{bmatrix} \end{array}$$

FORGETTING TRANSITION MATRIX

It is assumed that forgetting can occur during the interval between the initial performance test and the retention test for items in States LT, L or T. An item in State LT is treated as if there were two independent pieces of knowledge stored about the item, one acquired during training and another acquired during the initial test. Both pieces of information need to be lost in order for the item to drop back into State U.

$$\underset{\sim}{F} = \begin{array}{c} \\ K \\ LT \\ L \\ T \\ U \end{array} \begin{array}{c} \begin{array}{ccccc} K & LT & L & T & U \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & (1-\delta)(1-h) & (1-\delta)h & \delta(1-h) & \delta h \\ 0 & 0 & 1-\delta & 0 & \delta \\ 0 & 0 & 0 & 1-h & h \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \end{array}$$

VECTOR FOR PROBABILITY OF A CORRECT RESPONSE

The following vector gives for each state the probability that a correct response will be made when a soldier is tested on an item for which the soldier's level of knowledge is in that state.

$$\underset{\sim}{c} = \begin{array}{c} \\ K \\ LT \\ L \\ T \\ U \end{array} \begin{array}{c} \\ \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 0 \end{bmatrix} \end{array}$$

RESPONSE PROBABILITIES

Theoretical expressions for all response probabilities of interest can be given in terms of products of the above matrices and vectors. In particular, expressions are desired for the following probabilities:

P_E = Probability of a correct response to an item on the initial test for soldiers in experimental group E (where E = TL, TO CL or CO).

P_{BL} = Probability of a correct response to an item on the initial test for baseline soldiers.

P'_E = Probability of a correct response to an item on the retention test for soldiers in experimental group E.

P'_{BL} = Probability of a correct response to an item on the retention test for baseline soldiers.

The theoretical expressions for the above probabilities are as follows:

$$P_E = \underset{\sim}{s}.\underset{\sim}{A}.\underset{\sim}{c} = k + \ell(1-k)$$

$$P_{BL} = \underset{\sim}{s}.\underset{\sim}{c} = k$$

$$P'_E = \underset{\sim}{s}.\underset{\sim}{A}.\underset{\sim}{B}.\underset{\sim}{F}.\underset{\sim}{c} = k + \{t(1-h) + \ell(1-\delta)[1-t(1-h)]\}(1-k)$$

$$P'_{BL} = \underset{\sim}{s}.\underset{\sim}{B}.\underset{\sim}{F}.\underset{\sim}{c} = k + t(1-h)(1-k)$$

While not explicit in the above notation, the values of ℓ and δ depend on both the test being administered and the experimental group under consideration. The values of t and h depend only on the test. All parameters are assumed to be constant across soldiers within an experimental group. Another point to bear in mind is that the values of the forgetting parameters δ and h depend on the time interval between the initial test and the retention test. Specifically, the assumption made here for the purpose of generating retention curves is that δ and h are exponential functions of time. That is,

$$\delta(s) = 1-r_1^s, \quad 0 < r_1 < 1$$

$$h(s) = 1-r_2^s, \quad 0 < r_2 < 1$$

where s is the time interval between the initial performance test and the retention test and r_1 and r_2 are rate parameters.

PARAMETER ESTIMATES

Moments estimates of the model parameters may be obtained by solving the above four response probability equations for k, ℓ, δ and $t(1-h)$. The available data do not allow separate estimates for t and h. The following solutions are obtained:

$$k = P_{BL}$$

$$\ell = \frac{P_E - P_{BL}}{1-P_{BL}}$$

$$\delta = 1 - \frac{(1-P_{BL})\ (P'_E - P'_{BL})}{(1-P'_{BL})\ (P_E - P_{BL})}$$

$$t(1-h) = \frac{P'_{BL} - P_{BL}}{1-P_{BL}}$$

The parameter estimates are then obtained by substituting the observed proportion of correct responses for the appropriate response probabilities in the above expressions. The correspondence between the quantities P(L), P(L′) and P(R) as defined in the Technical Supplement and the parameters defined in this appendix is as follows:

$$P(L) = \ell$$

$$P(L') = \ell(1-\delta)$$

$$P(R) = 1-\delta$$

DISCUSSION

The model presented here is intended to be a highly simplified representation of the learning and retention processes involved in the TEC training effectiveness experiments. While a number of the simplifying assumptions included in the model might seem questionable, it can be shown that the substitution of more detailed and complex assumptions has little effect on the estimates of the quantities of real interest, i.e., P(L), P(L′) and P(R). For instance, it is assumed that for an item in State U, the probability of a correct response to that item is 0. It might seem more reasonable to include a parameter that allows for the possibility of guessing the correct response to the item. Inclusion of such a parameter makes the response probability expressions more complex, but has no effect on the estimates of the critical parameters ℓ and δ. As another example, it is assumed that during the initial test transition to State LT occurs with equal probability from State U and State L. It can be argued that it would be closer to the truth to assume that there is no State LT - that only items in State U are affected by the initial test. However, parameter estimates obtained under this alternative assumption are very close to those obtained from the model with State LT. Finally, it is clearly an oversimplification to assume that the same parameter values apply to all individuals in an experimental group. Again, however, it can be shown that allowing for individual differences will not result in any substantial changes in the conclusions drawn from the model.

APPENDIX D SUMMARY OF AC QUESTIONNAIRE RESPONSES

Table D-1

AC PRIMARY MOS DISTRIBUTION

Lesson Category	Training Group	Number of Men by MOS								
		11B	11C	11D	11E	13B	13E	16P	16R	Other MOS
M60	TL	2	4	2	7	6	3	3	2	4
	TO	8	2	2	6	6	3	4	2	2
	CL	10	0	0	6	6	3	5	0	4
	CO	5	4	3	7	6	2	3	1	4
	BL	8	1	2	7	6	3	2	3	4
Squad Radio	TL	18	2	0	0	0	0	0	0	0
	TO	21	3	0	0	0	0	0	0	0
	CL	19	2	0	0	0	0	0	0	0
	CO	21	0	0	0	0	0	0	0	2
	BL	12	8	0	0	0	0	0	0	1
M551	TL	1	0	5	17	0	0	0	0	1
	TO	1	0	5	15	0	0	0	0	2
	CL	0	0	7	14	0	0	0	0	1
	CO	1	0	5	16	0	0	0	0	1
	BL	0	0	4	23	0	0	0	0	1
Gunner's Quadrant	TL	0	0	0	0	21	3	0	0	0
	TO	0	0	0	0	21	3	0	0	0
	CL	0	0	0	0	21	3	0	0	0
	CO	0	0	0	0	22	3	0	0	0
	BL	0	0	0	0	22	3	0	0	0
TADDS	TL	0	0	0	0	0	0	8	9	2
	TO	0	0	0	0	0	0	11	9	1
	CL	0	0	0	0	0	0	10	8	1
	CO	0	0	0	0	0	0	11	8	5
	BL	0	0	0	0	0	0	8	11	4

Table D-2

AC PAY GRADE DISTRIBUTION

Lesson Category	Training Group	Number of Men in Pay Grades					
		E1	E2	E3	E4	E5	E6
M60	TL	1	5	3	19	4	1
	TO	2	6	11	10	6	0
	CL	2	10	10	11	1	0
	CO	1	3	11	11	9	0
	BL	3	9	5	11	7	1
Squad Radio	TL	3	2	4	10	1	0
	TO	2	1	6	12	2	1
	CL	4	1	8	7	1	0
	CO	0	2	10	10	1	0
	BL	1	2	4	10	4	0
M551	TL	0	7	2	9	6	0
	TO	3	6	4	7	3	0
	CL	1	4	3	12	2	0
	CO	0	4	6	11	2	0
	BL	0	8	5	6	8	1
Gunner's Quadrant	TL	0	9	5	10	0	0
	TO	2	8	5	8	1	0
	CL	1	8	4	10	1	0
	CO	3	5	2	15	0	0
	BL	2	7	2	11	2	1
TADDS	TL	1	7	6	2	3	0
	TO	0	5	12	2	2	0
	CL	1	5	8	3	2	0
	CO	1	8	4	8	3	0
	BL	2	6	7	7	1	0

Table D-3

AC TIME IN SERVICE DISTRIBUTION

Lesson Category	Training Group	Number of Men by Time In Service					
		<1 Year	1-2 Years	2-3 Years	3-4 Years	4+Years	No Response
M60	TL	6	11	8	3	5	0
	TO	10	11	4	2	8	0
	CL	13	10	4	1	6	0
	CO	7	9	8	2	9	0
	BL	12	8	4	1	11	0
Squad Radio	TL	3	10	3	1	3	0
	TO	7	8	3	2	4	0
	CL	3	11	3	0	4	0
	CO	4	11	4	2	2	0
	BL	1	11	3	3	3	0
M551	TL	6	3	6	2	7	0
	TO	11	5	2	2	3	0
	CL	5	8	7	0	2	0
	CO	6	8	7	1	1	0
	BL	8	7	3	1	8	1
Gunner's Quadrant	TL	10	4	5	1	4	0
	TO	8	10	0	1	5	0
	CL	10	8	2	3	1	0
	CO	9	9	1	1	5	0
	BL	10	6	2	1	6	0
TAADS	TL	8	5	1	2	2	1
	TO	6	10	2	2	1	0
	CL	9	5	2	1	2	0
	CO	11	5	4	1	3	0
	BL	9	4	6	4	0	0

Table D-4

VIEWING PRIOR TO EXPERIMENT BY AC SOLDIERS OF TEC LESSONS IN THEIR SUBJECT AREA

Lesson Category	Training Group	Reports of Soldiers: Prior Viewing	No Prior Viewing	No Response
M60	TL	3	31	0
	TO	4	31	0
	CL	4	30	1
	CO	2	30	2
	BL	4	33	0
Squad Radio	TL	0	20	0
	TO	0	24	0
	CL	1	20	2
	CO	1	22	0
	BL	2	19	1
M551	TL	1	22	0
	TO	1	23	0
	CL	0	24	0
	CO	0	24	0
	BL	0	26	1
Gunner's Quadrant	TL	2	22	0
	TO	4	20	0
	CL	0	24	0
	CO	2	23	0
	BL	0	24	0
TADDS	TL	4	15	0
	TO	3	19	0
	CL	1	18	0
	CO	3	20	1
	BL	1	20	2

Table D-5

AC PREVIOUS TRAINING DISTRIBUTION

Lesson Category	Training Group	Previous Training: No Training	Initial Entry Tng (IET) only[a]	After IET only	Both IET and after IET	No Response
M60	TL	11	14	1	7	0
	TO	10	10	6	9	0
	CL	5	12	1	14	2
	CO	4	15	4	10	2
	BL	6	14	3	13	0
Squad Radio	TL	6	10	2	2	0
	TO	8	9	4	3	0
	CL	6	7	0	6	2
	CO	9	8	2	4	0
	BL	4	7	4	5	1
M551	TL	17	3	4	0	0
	TO	20	0	2	1	0
	CL	17	3	2	0	0
	CO	18	2	3	0	0
	BL	25	1	1	0	1
Gunner's Quadrant	TL	7	4	7	6	0
	TO	10	5	4	4	1
	CL	10	4	4	6	0
	CO	9	4	7	5	0
	BL	13	7	3	1	1
TADDS	TL	7	8	2	2	0
	TO	10	10	0	1	0
	CL	9	8	1	1	0
	CO	11	6	0	5	2
	BL	11	10	1	1	0

[a] BCT and/or AIT

APPENDIX E AC CONVENTIONAL INSTRUCTION

M60: 23 instructors from 12 battalions.

All instructors were E5 or E6 (in one armor battalion an E5 taught both M60 classes).

Mean instruction time was 2.0 hours.

Squad Radio: 6 instructors from 3 battalions.

All instructors were E5 or E6.

Mean instruction time was 1.5 hours.

M551: 5 instructors from 3 battalions.

2 instructors were E6, 2 were 03 and 1 was an 01 (the 01 taught 2 classes).

Mean instruction time was 1.5 hours.

Gunner's Quadrant: 6 instructors from 3 battalions.

All instructors were E5 or E6.

Mean instruction time was 1.7 hours.

TADDS: 5 instructors from 3 battalions.

1 instructor was an E4, 4 were E6 (1 E6 taught 2 classes).

Mean instruction time was 1.6 hours.

APPENDIX F SUMMARY OF NG QUESTIONNAIRE RESPONSES

Table F-1

RC PRIMARY MOS DISTRIBUTION

Lesson Category	Training Group	Number of Men by MOS							
		11B	11C	11D	11E	13B	13E	16F	Other MOS
M60	TL	7	0	1	4	2	0	7	8
	TO	7	2	1	4	3	0	8	7
	CL	6	0	4	3	5	0	6	8
	CO	1	5	1	4	5	0	8	4
	BL	6	1	3	5	3	0	7	6
Squad Radio	TL	16	1	0	0	1	0	0	4
	TO	9	5	0	0	1	0	0	5
	CL	15	3	0	0	1	0	0	2
	CO	16	0	0	0	0	0	0	5
	BL	12	3	0	0	0	0	0	5
M551	TL	2	0	2	12	0	0	0	6
	TO	0	1	1	13	0	0	0	3
	CL	0	0	5	10	0	0	0	4
	CO	1	0	3	11	0	0	0	3
	BL	0	0	1	10	0	0	0	0
Gunner's Quadrant	TL	1	0	0	0	11	0	0	9
	TO	0	0	0	0	10	5	0	6
	CL	0	0	0	0	19	1	0	4
	CO	0	0	0	0	15	2	0	4
	BL	0	0	0	0	13	2	0	7
TADDS	TL	0	0	0	0	0	0	11	7
	TO	0	0	0	0	0	0	12	7
	CL	0	0	0	0	0	0	12	4
	CO	0	0	0	0	0	0	12	7
	BL	0	0	0	0	0	0	12	6

Table F-2

RC PAY GRADE DISTRIBUTION

Lesson Category	Training Group	Number of Men in Pay Grades							
		E1	E2	E3	E4	E5	E6	E7	No Response
M60	TL	0	2	3	7	9	3	1	4
	TO	1	2	5	12	8	0	0	4
	CL	1	3	7	8	7	3	0	3
	CO	0	1	5	8	7	3	0	4
	BL	3	3	1	7	8	5	1	3
Squad Radio	TL	1	5	8	2	5	1	0	0
	TO	0	2	2	2	3	2	1	8
	CL	0	6	7	5	2	1	0	0
	CO	0	3	5	3	1	1	1	7
	BL	0	2	2	7	1	1	0	7
M551	TL	0	0	5	6	8	3	0	0
	TO	0	2	3	4	5	4	0	0
	CL	0	1	6	5	6	1	0	0
	CO	0	1	2	10	4	0	1	0
	BL	0	0	2	2	3	4	0	0
Gunner's Quadrant	TL	0	3	4	6	7	0	1	0
	TO	0	1	3	8	6	2	0	2
	CL	0	1	3	11	5	3	0	1
	CO	1	1	5	8	4	0	0	2
	BL	1	2	6	5	6	0	0	2
TADDS	TL	0	1	1	9	4	1	0	2
	TO	0	1	2	2	8	4	1	1
	CL	0	0	0	5	9	1	0	1
	CO	0	0	5	5	6	1	1	1
	BL	0	0	0	3	11	3	1	0

Table F-3

RC TIME IN SERVICE DISTRIBUTION

Lesson Category	Training Group	Number of Men by Time In Service									
		Years									No Response
		<1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8+	
M60	TL	1	1	3	2	2	4	7	0	5	4
	TO	5	3	3	3	2	1	5	2	3	5
	CL	2	4	3	2	3	4	4	0	7	3
	CO	0	5	1	2	1	4	0	1	9	5
	BL	4	1	2	0	4	4	3	2	8	3
Squad Radio	TL	4	4	2	2	3	4	1	2	0	0
	TO	1	3	1	0	1	2	1	0	3	8
	CL	4	10	2	0	0	1	1	3	0	0
	CO	2	4	2	1	2	0	0	0	2	8
	BL	0	2	5	0	1	3	0	0	2	7
M551	TL	3	2	3	1	0	4	1	2	6	0
	TO	2	1	2	2	3	1	2	3	2	0
	CL	0	1	3	1	1	6	3	2	2	0
	CO	0	1	2	1	4	4	1	4	1	0
	BL	0	2	2	0	1	3	1	0	2	0
Gunner's Quadrant	TL	4	2	1	4	0	0	2	1	6	1
	TO	1	1	1	4	2	2	3	1	6	1
	CL	3	1	1	5	2	2	0	3	6	1
	CO	3	2	2	2	2	0	0	1	5	4
	BL	5	3	1	3	1	6	0	0	1	2
TADDS	TL	1	1	0	4	1	4	0	3	3	1
	TO	2	1	1	0	0	4	1	0	8	2
	CL	0	1	2	0	0	2	1	3	6	1
	CO	2	2	0	1	4	1	1	1	5	2
	BL	0	1	0	1	1	2	1	2	10	0

Table F-4

VIEWING PRIOR TO EXPERIMENT BY RC SOLDIERS OF TEC LESSONS IN THEIR SUBJECT AREA

Lesson Category	Training Group	Reports of Soldiers: Prior Viewing	Reports of Soldiers: No Prior Viewing	Reports of Soldiers: No Response
M60	TL	2	24	3
	TO	2	27	3
	CL	2	27	3
	CO	4	19	5
	BL	1	25	3
Squad Radio	TL	4	18	0
	TO	2	10	8
	CL	0	21	0
	CO	1	11	7
	BL	3	9	7
M551	TL	1	21	0
	TO	0	22	0
	CL	0	24	0
	CO	1	20	0
	BL	0	22	0
Gunner's Quadrant	TL	1	19	1
	TO	0	21	1
	CL	2	21	1
	CO	0	17	4
	BL	1	19	2
TADDS	TL	2	15	1
	TO	0	19	0
	CL	1	14	1
	CO	0	17	1
	BL	0	18	0

Table F-5

RC PREVIOUS TRAINING DISTRIBUTION

Lesson Category	Training Group	Previous Training: No Training	Initial Entry Tng (IET) only [a]	After IET only	Both IET and after IET	No Response
M60	TL	7	8	7	4	3
	TO	14	8	2	5	3
	CL	11	8	6	4	3
	CO	10	4	4	4	6
	BL	13	9	2	4	3
Squad Radio	TL	10	2	3	7	0
	TO	3	4	3	2	8
	CL	11	5	3	2	0
	CO	4	0	5	5	7
	BL	6	3	2	2	7
M551	TL	18	2	1	1	0
	TO	16	0	2	0	0
	CL	17	1	0	1	0
	CO	16	0	1	1	0
	BL	10	1	0	0	0
Gunner's Quadrant	TL	12	1	5	2	1
	TO	17	4	0	0	1
	CL	14	3	6	0	1
	CO	13	0	2	2	4
	BL	14	1	3	2	2
TADDS	TL	14	0	3	0	1
	TO	16	0	3	0	0
	CL	10	0	5	0	1
	CO	14	0	4	0	1
	BL	18	0	0	0	0

[a] BCT and/or AIT

APPENDIX G NG CONVENTIONAL INSTRUCTION

M60: 19 instructors from 12 battalions.

1 instructor was an 01, 1 was an E8 and all others were E5 or E6 (both classes were taught by 1 instructor in 2 armor battalions and 3 FA battalions).

Mean instruction time was 1.8 hours.

Squad Radio: 6 instructors from 3 battalions.

All instructors were E5 or E6.

Mean instruction time was 1.6 hours.

M551: 3 instructors from 3 battalions.

2 instructors were 01 and 1 was an 02 (all instructors taught 2 classes).

Mean instruction time was 1.4 hours.

Gunner's Quadrant: 6 instructors from 4 battalions.

1 instructor was an E5, 1 was an E6, 2 were 02 and 3 were 03 (the E5 and E6 each taught 2 classes).

Mean instruction time was 2.1 hours.

TADDS: 5 instructors from 3 battalions.

1 instructor was an E5, 3 were E6 and 1 was an 01 (1 E6 taught 2 classes).

Mean instruction time was 2.3 hours.

DISTRIBUTION

ARI Distribution List

4 OASD (M&RA)
2 HQDA (DAMI-CSZ)
1 HQDA (DAPE-PBR
1 HQDA (DAMA-AR)
1 HQDA (DAPE-HRE-PO)
1 HQDA (SGRD-ID)
1 HQDA (DAMI-DOT-C)
1 HQDA (DAPC-PMZ-A)
1 HQDA (DACH-PPZ-A)
1 HQDA (DAPE-HRE)
1 HQDA (DAPE-MPO-C)
1 HQDA (DAPE-DW)
1 HQDA (DAPE-HRL)
1 HQDA (DAPE-CPS)
1 HQDA (DAFD-MFA)
1 HQDA (DARD-ARS-P)
1 HQDA (DAPC-PAS-A)
1 HQDA (DUSA-OR)
1 HQDA (DAMO-RQR)
1 HQDA (DASG)
1 HQDA (DA10-PI)
1 Chief, Consult Div (DA-OTSG), Adelphi, MD
1 Mil Asst. Hum Res, ODDR&E, OAD (E&LS)
1 HQ USARAL, APO Seattle, ATTN: ARAGP-R
1 HQ First Army, ATTN: AFKA-OI-TI
2 HQ Fifth Army, Ft Sam Houston
1 Dir, Army Stf Studies Ofc, ATTN: OAVCSA (DSP
1 Ofc Chief of Stf, Studies Ofc
1 DCSPER, ATTN: CPS/OCP
1 The Army Lib, Pentagon, ATTN: RSB Chief
1 The Army Lib, Pentagon, ATTN: ANRAL
1 Ofc, Asst Sect of the Army (R&D)
1 Tech Support Ofc, OJCS
1 USASA, Arlington, ATTN: IARD-T
1 USA Rsch Ofc, Durham, ATTN: Life Sciences Dir
2 USARIEM, Natick, ATTN: SGRD-UE-CA
1 USATTC, Ft Clayton, ATTN: STETC-MO-A
1 USAIMA, Ft Bragg, ATTN: ATSU-CTD-OM
1 USAIMA, Ft Bragg, ATTN: Marquat Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Tng Dir
1 USA Quartermaster Sch, Ft Lee, ATTN: ATSM-TE
1 Intelligence Material Dev Ofc, EWL, Ft Holabird
1 USA SE Signal Sch, Ft Gordon, ATTN: ATSO-EA
1 USA Chaplain Ctr & Sch, Ft Hamilton, ATTN: ATSC-TE-RD
1 USATSCH, Ft Eustis, ATTN: Educ Advisor
1 USA War College, Carlisle Barracks, ATTN: Lib
2 WRAIR, Neuropsychiatry Div
1 DLI, SDA, Monterey
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-MR
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-JF
1 USA Arctic Test Ctr, APO Seattle, ATTN: STEAC-PL-MI
1 USA Arctic Test Ctr, APO Seattle, ATTN: AMSTE-PL-TS
1 USA Armament Cmd, Restone Arsenal, ATTN: ATSK-TEM
1 USA Armament Cmd, Rock Island, ATTN: AMSAR-TDC
1 FAA-NAFEC, Atlantic City, ATTN: Library
1 FAA-NAFEC, Atlantic City, ATTN: Hum Engr Br
1 FAA Aeronautical Ctr, Oklahoma City, ATTN: AAC-44D
2 USA Fld Arty Sch, Ft Sill, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DI-E
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DT-TP
1 USA Armor Sch, Ft Knox, ATTN: ATSB-CD-AD
2 HQUSACDEC, Ft Ord, ATTN: Library
1 HQUSACDEC, Ft Ord, ATTN: ATEC-EX-E-Hum Factors
2 USAEEC, Ft Benjamin Harrison, ATTN: Library
1 USAPACDC, Ft Benjamin Harrison, ATTN: ATCP-HR
1 USA Comm-Elect Sch, Ft Monmouth, ATTN: ATSN-EA
1 USAEC, Ft Monmouth, ATTN: AMSEL-CT-HDP
1 USAEC, Ft Monmouth, ATTN: AMSEL-PA-P
1 USAEC, Ft Monmouth, ATTN: AMSEL-SI-CB
1 USAEC, Ft Monmouth, ATTN: C, Facl Dev Br
1 USA Materials Sys Anal Agcy, Aberdeen, ATTN: AMXSY-P
1 Edgewood Arsenal, Aberdeen, ATTN: SAREA-BL-H
1 USA Ord Ctr & Sch, Aberdeen, ATTN: ATSL-TEM-C
2 USA Hum Engr Lab, Aberdeen, ATTN: Library/Dir
1 USA Combat Arms Tng Bd, Ft Benning, ATTN: Ad Supervisor
1 USA Infantry Hum Rsch Unit, Ft Benning, ATTN: Chief
1 USA Infantry Bd, Ft Benning, ATTN: STEBC-TE-T
1 USASMA, Ft Bliss, ATTN: ATSS-LRC
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA-CTD-ME
1 USA Air Def Sch, Ft Bliss, ATTN: Tech Lib
1 USA Air Def Bd, Ft Bliss, ATTN: FILES
1 USA Air Def Bd, Ft Bliss, ATTN: STEBD-PO
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Lib
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: ATSW-SE-L
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Ed Advisor
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: DepCdr
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: CCS
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCASA
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACO-E
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACC-CI
1 USAECOM, Night Vision Lab, Ft Belvoir, ATTN: AMSEL-NV-SD
3 USA Computer Sys Cmd, Ft Belvoir, ATTN: Tech Library
1 USAMERDC, Ft Belvoir, ATTN: STSFB-DQ
1 USA Eng Sch, Ft Belvoir, ATTN: Library
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-TD-S
1 USA Topographic Lab, Ft Belvoir, ATTN: STINFO Center
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-GSL
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATS-CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TE
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEX-GS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTS-OR
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-DT
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-CS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: DAS/SRD
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEM
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: Library
1 CDR, HQ Ft Huachuca, ATTN: Tech Ref Div
2 CDR, USA Electronic Prvg Grd, ATTN: STEEP-MT-S
1 HQ, TCATA, ATTN: Tech Library
1 HQ, TCATA, ATTN: AT CAT-OP-Q, Ft Hood
1 USA Recruiting Cmd, Ft Sheridan, ATTN: USARCPM-P
1 Senior Army Adv., USAFAGOD/TAC, Eglin AF Aux Fld No. 9
1 HQ USARPAC, DCSPER, APO SF 96558, ATTN: GPPE-SE
1 Stimson Lib, Academy of Health Sciences, Ft Sam Houston
1 Marine Corps Inst., ATTN: Dean-MCI
1 HQUSMC, Commandant, ATTN: Code MTMT
1 HQUSMC, Commandant, ATTN: Code MPI-20-28
2 USCG Academy, New London, ATTN: Admission
2 USCG Academy, New London, ATTN: Library
1 USCG Training Ctr, NY, ATTN: CO
1 USCG Training Ctr, NY, ATTN: Educ Svc Ofc
1 USCG, Psychol Res Br, DC, ATTN: GP 1/62
1 HQ Mid-Range Br, MC Det, Quantico, ATTN: P&S Div

1 US Marine Corps Liaision Ofc, AMC, Alexandria, ATTN: AMCGS–F
1 USATRADOC, Ft Monroe, ATTN: ATRO–ED
6 USATRADOC, Ft Monroe, ATTN: ATPR–AD
1 USATRADOC, Ft Monroe, ATTN: ATTS–EA
1 USA Forces Cmd, Ft McPherson, ATTN: Library
2 USA Aviation Test Bd, Ft Rucker, ATTN: STEBG–PO
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Library
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Educ Advisor
1 USA Aviation Sch, Ft Rucker, ATTN: PO Drawer O
1 HQUSA Aviation Sys Cmd, St Louis, ATTN: AMSAV–ZDR
2 USA Aviation Sys Test Act., Edwards AFB, ATTN: SAVTE–T
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA TEM
1 USA Air Mobility Rsch & Dev Lab, Moffett Fld, ATTN: SAVDL–AS
1 USA Aviation Sch, Res Tng Mgt, Ft Rucker, ATTN: ATST–T–RTM
1 USA Aviation Sch, CO, Ft Rucker, ATTN: ATST–D–A
1 HQ, DARCOM, Alexandria, ATTN: AMXCD–TL
1 HQ, DARCOM, Alexandria, ATTN: CDR
1 US Military Academy, West Point, ATTN: Serials Unit
1 US Military Academy, West Point, ATTN: Ofc of Milt Ldrshp
1 US Military Academy, West Point, ATTN: MAOR
1 USA Standardization Gp, UK, FPO NY, ATTN: MASE–GC
1 Ofc of Naval Rsch, Arlington, ATTN: Code 452
3 Ofc of Naval Rsch, Arlington, ATTN: Code 458
1 Ofc of Naval Rsch, Arlington, ATTN: Code 450
1 Ofc of Naval Rsch, Arlington, ATTN: Code 441
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Acous Sch Div
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L51
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L5
1 Chief of NavPers, ATTN: Pers-OR
1 NAVAIRSTA, Norfolk, ATTN: Safety Ctr
1 Nav Oceanographic, DC, ATTN: Code 6251, Charts & Tech
1 Center of Naval Anal, ATTN: Doc Ctr
1 NavAirSysCom, ATTN: AIR–5313C
1 Nav BuMed, ATTN: 713
1 NavHelicopterSubSqua 2, FPO SF 96601
1 AFHRL (FT) William AFB
1 AFHRL (TT) Lowry AFB
1 AFHRL (AS) WPAFB, OH
2 AFHRL (DOJZ) Brooks AFB
1 AFHRL (DOJN) Lackland AFB
1 HQUSAF (INYSD)
1 HQUSAF (DPXXA)
1 AFVTG (RD) Randolph AFB
3 AMRL (HE) WPAFB, OH
2 AF Inst of Tech, WPAFB, OH, ATTN: ENE/SL
1 ATC (XPTD) Randolph AFB
1 USAF AeroMed Lib, Brooks AFB (SUL–4), ATTN: DOC SEC
1 AFOSR (NL), Arlington
1 AF Log Cmd, McClellan AFB, ATTN: ALC/DPCRB
1 Air Force Academy, CO, ATTN: Dept of Bel Scn
5 NavPers & Dev Ctr, San Diego
2 Navy Med Neuropsychiatric Rsch Unit, San Diego
1 Nav Electronic Lab, San Diego, ATTN: Res Lab
1 Nav TrngCen, San Diego, ATTN: Code 9000–Lib
1 NavPostGraSch, Monterey, ATTN: Code 55As
1 NavPostGraSch, Monterey, ATTN: Code 2124
1 NavTrngEquipCtr, Orlando, ATTN: Tech Lib
1 US Dept of Labor, DC, ATTN: Manpower Admin
1 US Dept of Justice, DC, ATTN: Drug Enforce Admin
1 Nat Bur of Standards, DC, ATTN: Computer Info Section
1 Nat Clearing House for MH–Info, Rockville
1 Denver Federal Ctr, Lakewood, ATTN: BLM
12 Defense Documentation Center
4 Dir Psych, Army Hq, Russell Ofcs, Canberra
1 Scientific Advsr, Mil Bd, Army Hq, Russell Ofcs, Canberra
1 Mil and Air Attache, Austrian Embassy
1 Centre de Recherche Des Facteurs, Humaine de la Defense Nationale, Brussels
2 Canadian Joint Staff Washington
1 C/Air Staff, Royal Canadian AF, ATTN: Pers Std Anal Br
3 Chief, Canadian Def Rsch Staff, ATTN: C/CRDS(W)
4 British Def Staff, British Embassy, Washington
1 Def & Civil Inst of Enviro Medicine, Canada
1 AIR CRESS, Kensington, ATTN: Info Sys Br
1 Militaerpsykologisk Tjeneste, Copehagen
1 Military Attache, French Embassy, ATTN: Doc Sec
1 Medecin Chef, C.E.R.P.A.–Arsenal, Toulon/Naval France
1 Prin Scientific Off, Appl Hum Engr Rsch Div, Ministry of Defense, New Delhi
1 Pers Rsch Ofc Library, AKA, Israel Defense Forces
1 Ministeris van Defensie, DOOP/KL Afd Sociaal Psychologische Zaken, The Hague, Netherlands